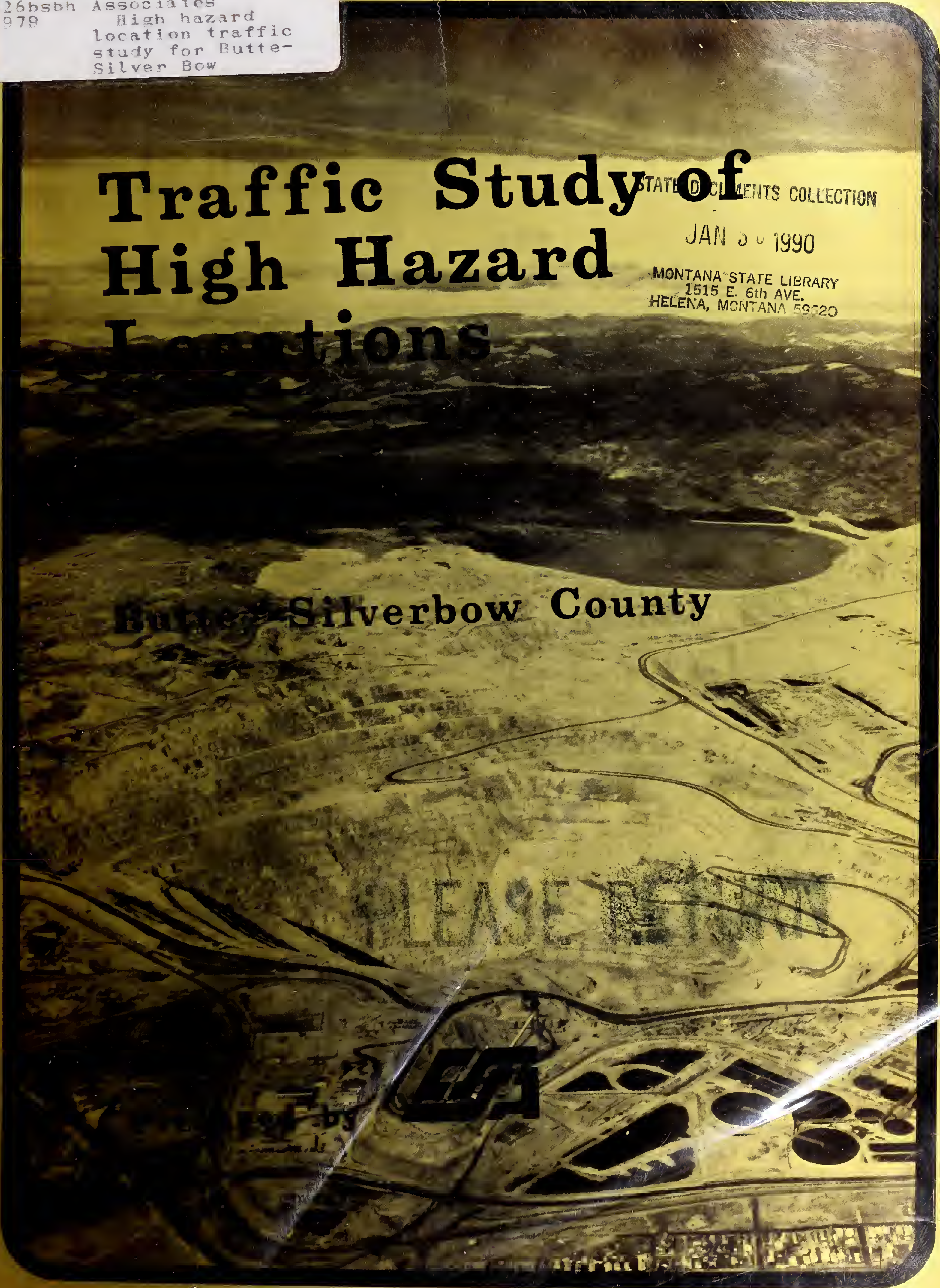
Traffic Study of High Hazard Locations



Butte-Silverbow County

HIGH HAZARD LOCATION

TRAFFIC STUDY

FOR

BUTTE-SILVER BOW

PREPARED BY

CHRISTIAN, SPRING, SIELBACH & ASSOCIATES

BILLINGS, MONTANA

Robert R. Marin

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INTRODUCTION

PURPOSE AND SCOPE

Butte-Silver Bow has embarked on a project to eliminate or alleviate existing problems at high hazard accident locations. With the preliminary technical and organizational assistance of the Department of Community Affairs, Highway Traffic Safety Division, twenty sites were selected for study.

The method of selection was based primarily on number of accidents at defineable locations. Even though many variables exist in the determination of hazardous locations, Butte-Silver Bow desired maximum impact as a result of the study and therefore chose a quantitative approach.

Since Butte-Silver Bow's road system is of an urbanized nature, major accident clusters occurred at intersections. The majority of sites are on Federal Aid Urban or Urban Extension routes which fall under a joint jurisdiction between Montana Department of Highways and Butte-Silver Bow.

The basic intent of this study is twofold.

1. To analyze each site relative to the degree of hazardness and establish a priority ranking for improvement projects based on the composite hazard ranking and cost-benefit ratios.
2. To provide a vehicle for Butte-Silver Bow to continue the program in the future.

The analysis contained within this report is based primarily on Report No. FHWA-RD-77-83 "Identification of Hazardous Locations" as refined by DCA Project No. 79-04-01-01. Modifications to these reports were made after intensive testing and error analysis. The methodology used to establish priority rankings in this report is tailored to Butte-Silver Bow's requirements and provides for flexibility in the analysis of county road system characteristics.

REPORT ORGANIZATION

The main text of this report which contains data analysis, improvement evaluations and recommendations for improvements to high hazard locations can be found in the tabbed sections entitled "Site Number X - Location". The basic format of those sections is as follows:

Narrative

- Location Description
- Existing Conditions
- Accident Analysis
- Short Term Improvements
- Long Term Improvements
- Economic Benefits
- Cost Estimate
- Cost Benefit Ratio

Tables

- Accident Summary
- Hazard Index Computations

Figures

- Turning Movement Volumes
- Collision Diagram
- Existing Condition Sketch
- Short Term Improvements Sketch
- Long Term Improvements Sketch

All other aspects of the study are indexed in the Table of Contents.

STUDY METHODOLOGY

BASIC STUDY OUTLINE

The study was segregated into three distinct phases which best achieved the purpose and scope of the traffic study. These phases are outlined as follows:

Phase 1 - Data Collection Phase; included the preliminary organization of the project including scheduling, form processing, field data collection and reduction of data. Accident data was obtained from reports filed at the Police Department and the Department of Highways. Traffic counts were taken at each location. The average daily traffic was determined by applying factors for hourly, daily and monthly variations.

Other data collected in the field included measurement of road widths and geometrics, an inventory of traffic control devices, turning movement counts and subjective observation of traffic operations.

Phase 2 - Analysis of Data; included the determination of hazard indices for each location by using the Federal Highway Administration Report No. FHWA-RD-77-83 "Identification of Hazardous Locations" and DCA Project No. 79-04-01-01 report. Computations involved with accidents, volumes, capacities, indicator values and other aspects of hazard indices were performed. From these computations a preliminary hazard ranking list was assembled.

Phase 3 - Evaluation of Corrective Measures and Priority Listing: included the determination of improvements that would reduce or eliminate certain types of hazards or hazards in general at the accident locations. Preliminary designs of those improvements included signing, geometric changes, signal modifications, channelization and reconstruction. The improvements were recommended on a short term basis. In some cases, long term improvements were recommended.

Cost effectiveness calculations of the improvements at each location were determined by preparing preliminary cost estimates and computing economic benefits to arrive at a cost-benefit ratio. The composite hazard index ranking and cost-benefit ratio determined the final priority listing.

HAZARD INDICES

Seven hazard indices were used as the preliminary basis of ranking hazardous sites. The following are brief descriptions of each index including data format, data collection and indicator scaling.

1. Number of Accidents - This indicator provides a historical background of accidents at the investigation site. In the case of Butte-Silver Bow a two and one-half year period between 1977 and June of 1979 was used. Since all accident forms are filed with the Butte-Silver Bow Police Department, data was relatively accessible. Continuation of the program using this indicator will present little difficulty since the number of accidents can be easily updated.

Figure 1 is a curve extracted from the FHWA report which is used to determine the indicator value. The data base is number of accidents per year. This indicator as all of the seven indicators used in the report is scaled between 0 and 100. An average of two accidents per year in a three year period indicates a hazardous location (indicator value of 33). Ten accidents on the average per year is used to designate a very hazardous location (indicator value of 67).

2. <u>Accident Rate Indicator</u> - This indicator somewhat compensates for any incomplete information provided by the number of accident indicators in that an exposure value is provided by the relationship between accidents and the total volumes of vehicles using the facility.

The data base for this indicator is expressed as the number of accidents per million entering vehicles. In the case of an intersection, "million entering vehicles" is the sum of the average daily approach volumes on all legs of the intersection, multiplied by the number of days in the analysis period.

The accident rate indicator is a very important part of the hazard index ranking method and data collection is possible only when a continued program of traffic counting has been performed. Spot counts adjusted by yearly volume increases, seasonal variations, daily variations, and hourly variations were necessary at most sites to develop an average daily traffic figure applied to the analysis period since documented counts were not available.

Figure 2 represents the graphic plot of accident rate versus indicator value. As before, the indicator value ranges between 0 and 100.

3. <u>Accident Severity Indicator</u> - Although there are many factors involved in the severity of accidents, statistical studies over a significant number of years have given fairly reliable dollar values in terms of economic loss for each type of accident. The accident severity indicator correlates a probable cause and effect relationship which aids in the determination of the level of accident reduction measures required. Severity values can also be used as a determinant of benefits resulting from various improvements.

The data base for accident severity is average relative severity in thousands of dollars. Data collection necessary for the use of the severity index is made possible by the accident report form.

Table 1 presents the relative severity index values for each type of accident. Once the type of accident has been established Figure 3 enables the user to assess an indicator value. Figure 3 is a graphic plot of the average severity in thousands of dollars versus the indicator value which is based on a scale of 0 to 100.

TABLE 1

RELATIVE SEVERITY INDEX*

TYPE OF ACCIDENT	RSI	
Multi-Vehicle, At Intersection	Urban	Rural
Entering at angle	$ 4,300	$14,400
From same direction -- both going straight	2,800	5,100
From same direction -- one turn, one straight	2,500	5,100
From same direction -- one stopped	3,800	5,200
From same direction -- all others	2,000	6,300
From opposite direction -- both going straight	4,000	20,000
From opposite direction -- one left turn, one straight	4,400	15,400
From opposite direction -- all others	2,700	3,800
Not Stated	3,800	5,200
Multi-Vehicle, Non-Intersection		
Going opposite direction -- both moving	$ 4,400	$19,600
Going same direction -- both moving	2,900	8,100
One car parked	1,600	2,400
One car stopped in traffic	4,200	6,800
One car entering parked position	1,900	2,300
One car leaving parked position	1,200	2,700
One car entering alley or driveway	3,400	6,000
One car leaving alley or driveway	2,000	4,400
All others	1,700	7,600
Not Stated	3,400	6,000
Motor Vehicle with Pedestrian, At Intersection and Non-Intersection		
Vehicle going straight	$20,000	$49,000
Vehicle turning right	13,600	11,200
Vehicle turning left	17,100	11,200
Vehicle backing	20,600	11,200
All Others	14,500	11,200
Not stated	11,200	11,200

*FHWA-RD-77-83 "Identification of Hazardous Locations"

TABLE 1 (Continued)

TYPE OF ACCIDENT	RSI	
Single Vehicle, at Intersection	Urban	Rural
Collision with train	$26,700	$39,100
Collision with bicycle	13,100	31,900
Injury in vehicle, jacknifed	5,200	2,000
Collision with fixed object in road	5,500	7,000
Overturned in road	9,200	7,500
Left road	5,200	12,300
Single Vehicle, Non-Intersection		
Collision with train	$26,700	$39,100
Collision with bicycle	13,100	31,900
Injury in vehicle, jacknifed	5,200	2,000
Collision with fixed object in road	6,300	9,200
Overturned in road	10,000	9,400
Left road at curve	7,600	12,400
Left road on straight road	5,200	10,500
Other One Motor Vehicle, At Intersection and Non-Intersection		
Fell from moving vehicle	$15,000	$57,200
Collision with animal	4,800	1,800
Collision with other object	4,700	4,400
All Others	5,200	2,000
Not Stated	3,200	3,400

4. Volume to Capacity Ratio Indicator - This indicator not only produces exposure rates but also incorporates existing roadside features and conditions such as traffic type, turning directions, volume mix, and number of lanes.

Computation of the volume capacity indicator is expressed as follows:

$$\frac{V}{C} = \frac{ADT}{(24)\ \text{Capacity}}$$

Data required for the volume capacity ratio involves field measurements of existing geometrics, turning counts and volume mix. The capacity of each section of road or intersection is computed through methodolgy presented in the Highway Capacity Manual - 1964. Although this indicator is cumbersome to use by non-experienced personnel, its inclusion is considered necessary and correlates well in hazardous index ranking.

Figure 4 presents a graphic plot of the volume capacity ratio versus the indicator value which is also scaled between 0 and 100.

5. Sight Distance Indicator - This indicator is of significant value in rural locations, especially at intersecting roads. Even though the weighting factor in the hazard index computation is low, it is still considered valuable in determining deficiencies on unimproved county roads.

The data format for using the sight distance indicator is the ratio of actual sight distance to desirable sight distance. Table 2 presents the minimum stopping sight distance on wet pavements for various design speeds. Actual stopping sight distance is the distance from the drivers position to the point where a stop may be required to avoid a hazardous maneuver or direct collision.

The data format for this indicator is the sight distance ratio of actual over desirable. Collection of the sight distance data requires field measurements of sight distance and determination of average travel speeds. Figure 5 presents a graphic plot of the sight distance ratio versus the indicator value which ranges from 0 to 100. In this report, Figure 5 was changed from the original FHWA-RD-77-83 report. All sites in this study were originally indexed at 100 due to the sight distance restrictions found in the urban area. In order to present a degree of relativity between sites, the curve was plotted from '0' on the actual/desirable scale and was transitioned to the original curve. The intent of the indicator was not significantly compromised by this modification, since the curve is concave downward in the upper indicator range.

TABLE 2

MINIMUM STOPPING SIGHT DISTANCE*

(Wet Pavements)

DESIGN SPEED mph	(kph)	STOPPING SIGHT DISTANCE FT.	(m)
30	(48.3)	200	(61.0)
40	(64.4)	275	(83.8)
50	(80.4)	350	(106.7)
60	(96.5)	475	(144.8)
70	(112.6)	600	(182.9

*FHWA-RD-77-83 "Identification of Hazardous Locations"

6. Driver Expectancy Indicator - This indicator relates human behavior factors to existing road conditions. The value of this indicator is realized in the fact that the roadway geometrics and roadside culture are evaluated on a human judgement basis.

The data format for the driver expectancy index is the problem rating scale. Being a subjective indicator, the degree of expectancy is rated on a scale from 1 to 6 and the expectancy rating varies linearly with the indicator value as shown in Figure 6. The expectancy rating form can be found in the FHWA report for further reference.

7. Information System Deficiencies Indicator - This indicator also provides a value or subjective judgement on the sufficiency of traffic control devices which transfer necessary information to the operator.

The data format for the information system deficiencies indicator is similar to that of the driver expectancy indicator in that a value form is used

to provide a rating between 1 and 6. The rating for this indicator is also plotted linearly between the indicator range values of 0 to 100 and is shown on Figure 7. The value rating form is for the information system deficiencies indicator. It is also presented in the FHWA report for futher reference.

HAZARD RANKING

Once all of the data has been collected and the indicator value has been computed, indicator values and necessary data is transferred to the hazard index basic computation sheet. Each indicator is weighted in accordance with the FHWA Report. The weighting factors are fractional portions of unity. When all nine indicators established in FHWA report are used, the sum of weights is equal to one. In the case of Butte-Silver Bow, two indicators were omitted, the Traffic Conflict Indicator and the Erratic Maneuvers Indicators. They were omitted due to the limited funding and scope of the study. Their exclusion from the study was not felt to be any deterrent in the ranking of hazardous sites. The use of seven indicators provides an 88.6% confidence of strength of evaluation.

The results of the hazard index computation sheet are summarized in matrix form in order to arrive at a preliminary hazard index ranking of all twenty sites. Ranked sites are listed in decreasing order of hazardness from 1 to 20.

COST-BENEFIT RATIOS

Costs - are developed by preliminary estimation of required quantities based on current prices as tabulated from average bid prices of similar projects. The costs should in no way be considered a quote or final estimate of actual work.

Even though Butte-Silver Bow maintenance crews are capable of performing a good deal of the work, the costs are based on contract prices in order to correlate with costs requiring contract bid letting. The costs also do not include administrative, design details or field layout which is required in some recommended improvements. Engineering design will generally be required to produce contract plans and specifications. These costs should be evaluated prior to planning improvement projects.

Benefits - are estimated by applying accident reduction forecasts based on the type of improvement recommended. The forecasts are based on the subjective evaluation by an experienced traffic engineer. This evaluation is aided by knowledge of accident experience at similar intersections with the improvements existing. Also statistical studies relating certain improvements to accident reduction are used as a guide ie, Roy Jorgenson and Associates, "Evaluation of Criteria for Safety Improvements on the Highway" (Washington, D.C.: U.S. Bureau of Public Roads, Office of Highway Safety, 1966, p. 316).

The forecasted reduction is expressed as a precentage of each type of accident. This percentage is multiplied by the percentage of all accidents represented by each type. The total percent reduction of all accidents at each site is the sum of all accidents reduction percentages for each type.

The basic formula used to compute benefits in this report is:

(% Reduction) x (Accidents/Year) x (Useful Project Life)

x (Average Severity in Dollars)

Where:	% Reduction	=	Fractional Reduction of all Accidents
	Accident Rate	=	Number of Accidents ÷ Number of Reporting Years
	Useful Project Life	=	5 years for signing projects, 20 years for reconstruction
	Average Severity in Dollars	=	Data Value of Accident Severity shown on Hazard Index Computation Sheet

If applied consistently the economic benefit computation will provide a realistic estimate of average economic savings to the general society. The benefit amount should not be interpreted as a dollar value that Butte-Silver Bow will receive as a result of dollar outlay. It is just a figure used to quantify the economic benefit to society that would occur if a certain number of accidents did not occur.

Ratio - of costs to benefits provides a reference as to the value of the recommended improvements. It is the desire of any improvement project to have a cost-benefit (C/B) ratio less than 1.0. If the C/B exceeds 1.0 the project is not justified. The value of a project is therefore inversely proportional to the value of the C/B.

PRIORITY INDEX

The ranking site improvement priorities cannot be directly dependent on the hazard ranking of the twenty sites. The value of the improvements must enter into the priority listing in the form of the cost-benefit ratio (C/B). The method of developing a composite Hazard Index - C/B listing must not be dependent on the number of locations studied. Therefore, a correlation of scale between the C/B ratio and hazard indicator value was developed on the following assumptions:

1. The contributing conditions creating hazards at each site and the resulting hazard ranking is relatively independent of the cost of correcting these conditions.

2. Benefits to be derived from correcting hazardous situations at each site is indirectly proportional to the degree of hazardness.

3. The cost-benefit ratio by virtue of benefit computation is indirectly proportional to the number of accidents indicator and severity indicator both of which are curvelinear functions.

4. The cost-benefit ratios can be value rated on a scale of 0 to 100 based on a curvilinear function.

5. The C/B ratio of 1.0 is equivalent to an indicator value of 0 and the C/B ratio value of 0.01 is equivalent to an indicator value of 100.

Based on these assumptions a graphic plot of the C/B ratio versus C/B indicator value has been established and it is shown in Figure 8. Since it has been graphed on semi-log paper the line appears linear.

Since the relative weighting of cost-benefits and hazardness is a controversial subject which would require research beyond the scope of this report,

it is felt that the priority index should be based on 33% weighting for the cost-benefit ratio and 67% weight on the hazard index. Therefore, to establish a priority index the following formula has been devised:

$$\text{Priority Index} = (\text{Hazard Index}) \times (0.67) + (\text{Cost-Benefit Indicator}) \times (0.33)$$

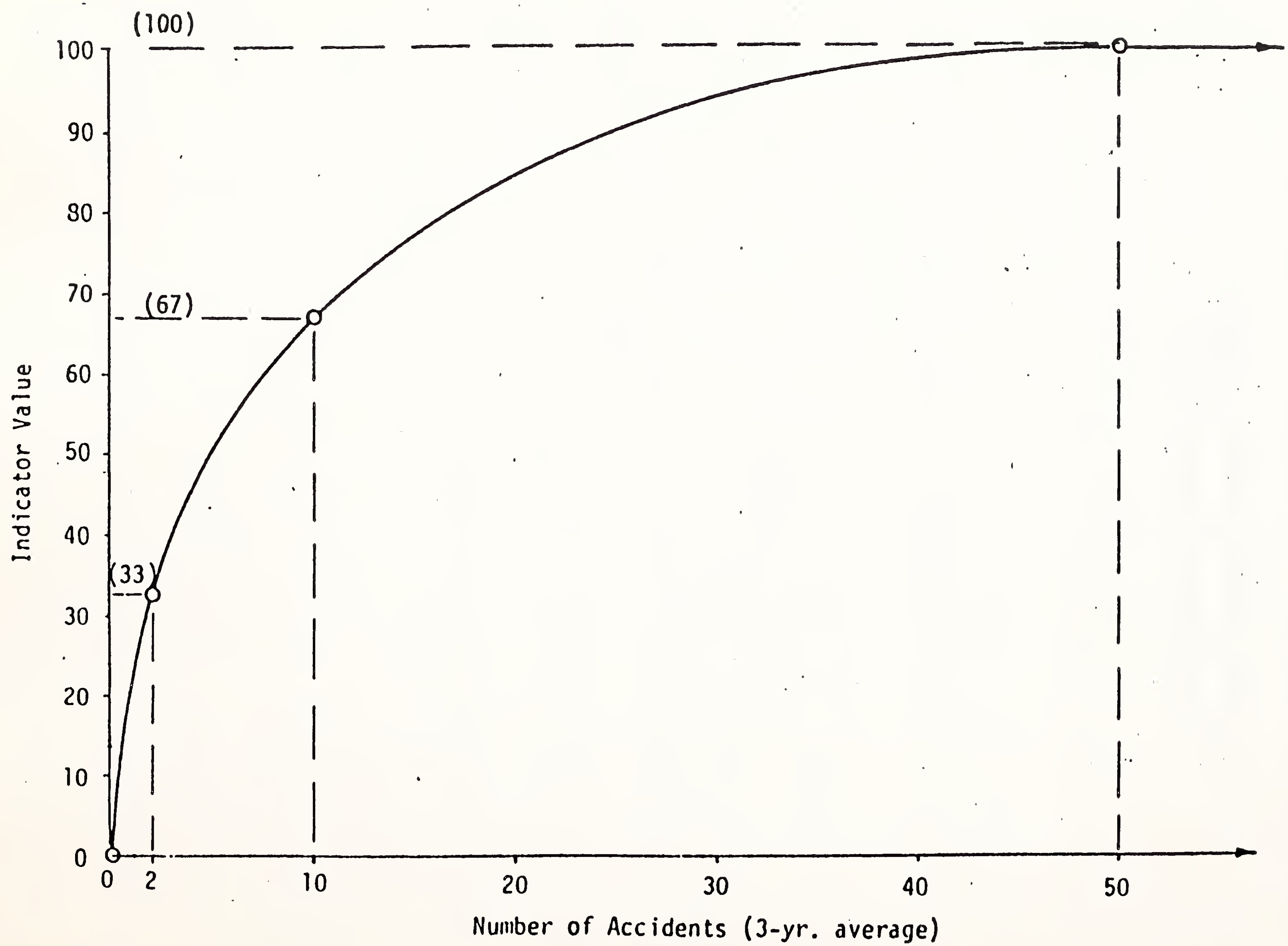


Figure 1. Indicator values for number of accidents.

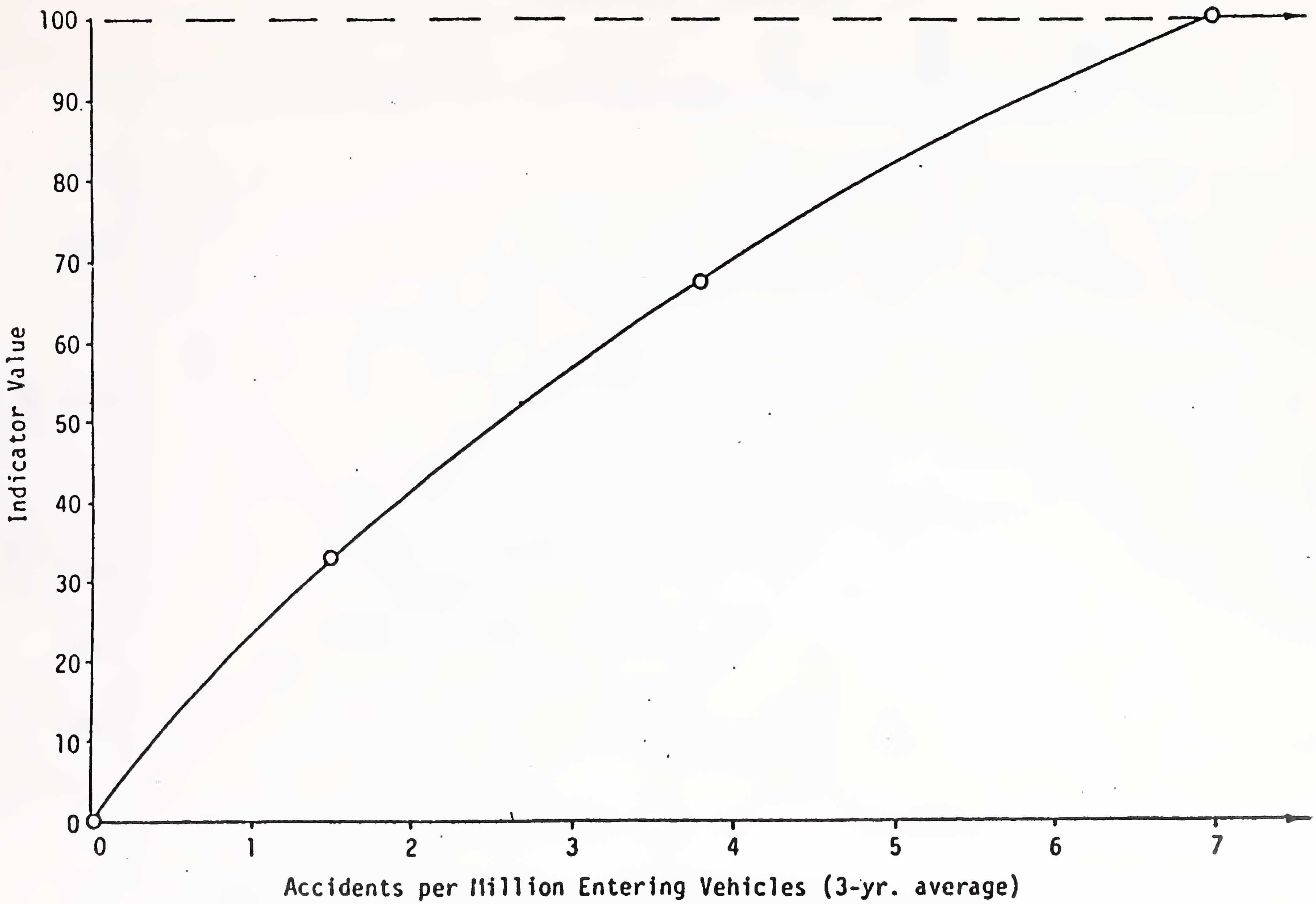


Figure 2. Indicator values for accident rate.

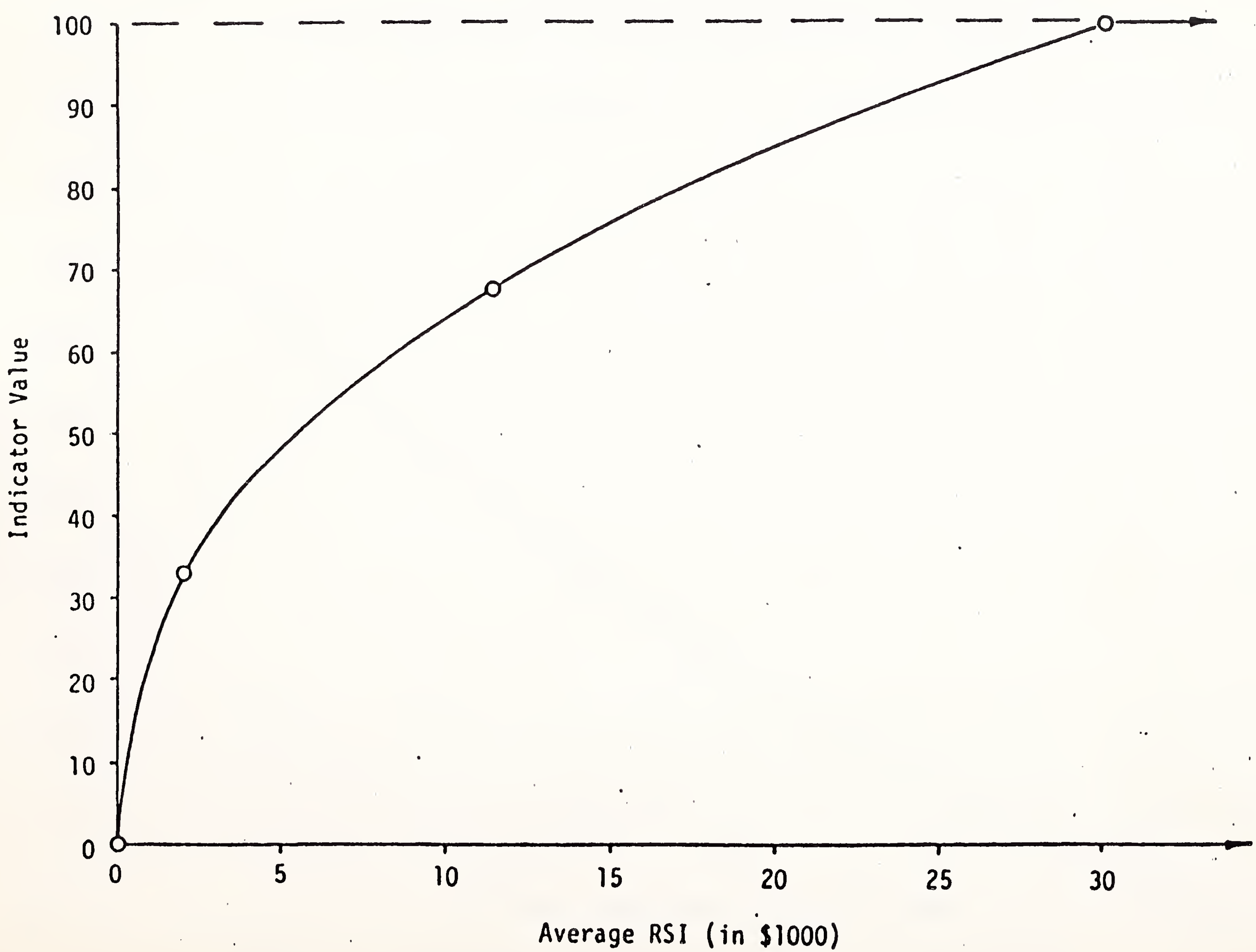


Figure 3. Indicator value for accident severity.

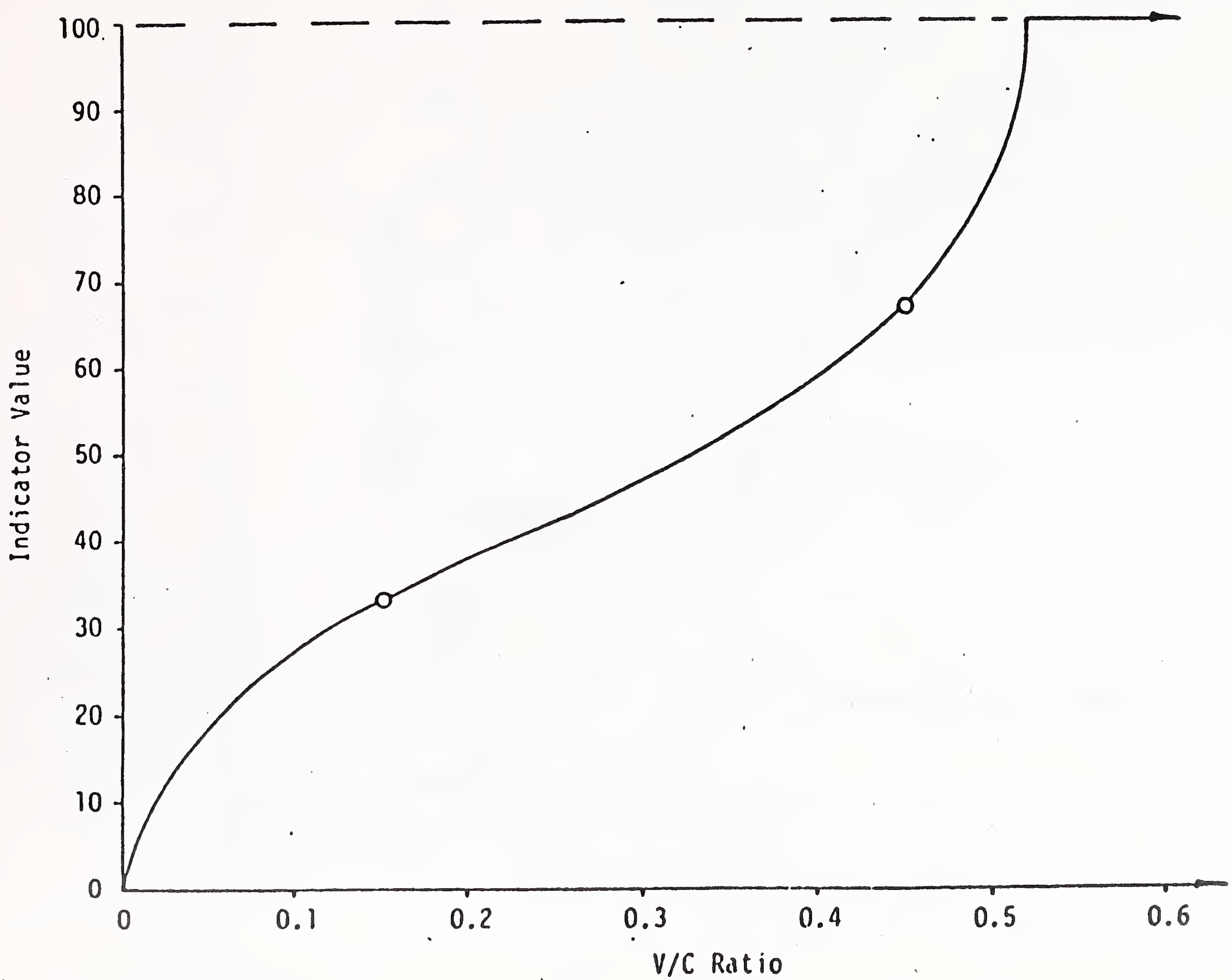


Figure 4. Indicator values for V/C ratio.

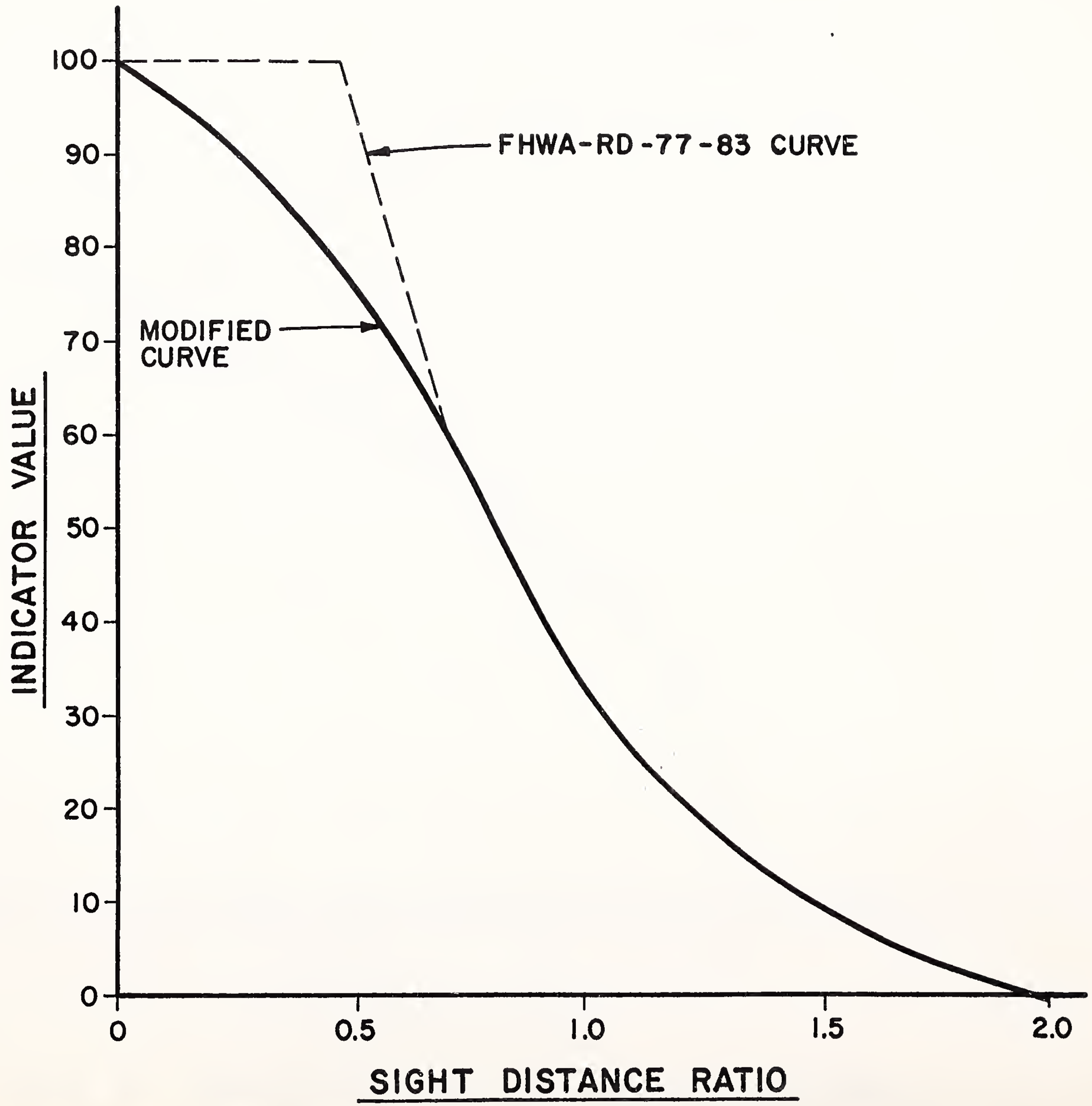


FIGURE 5 INDICATOR VALUES FOR SIGHT DISTANCE

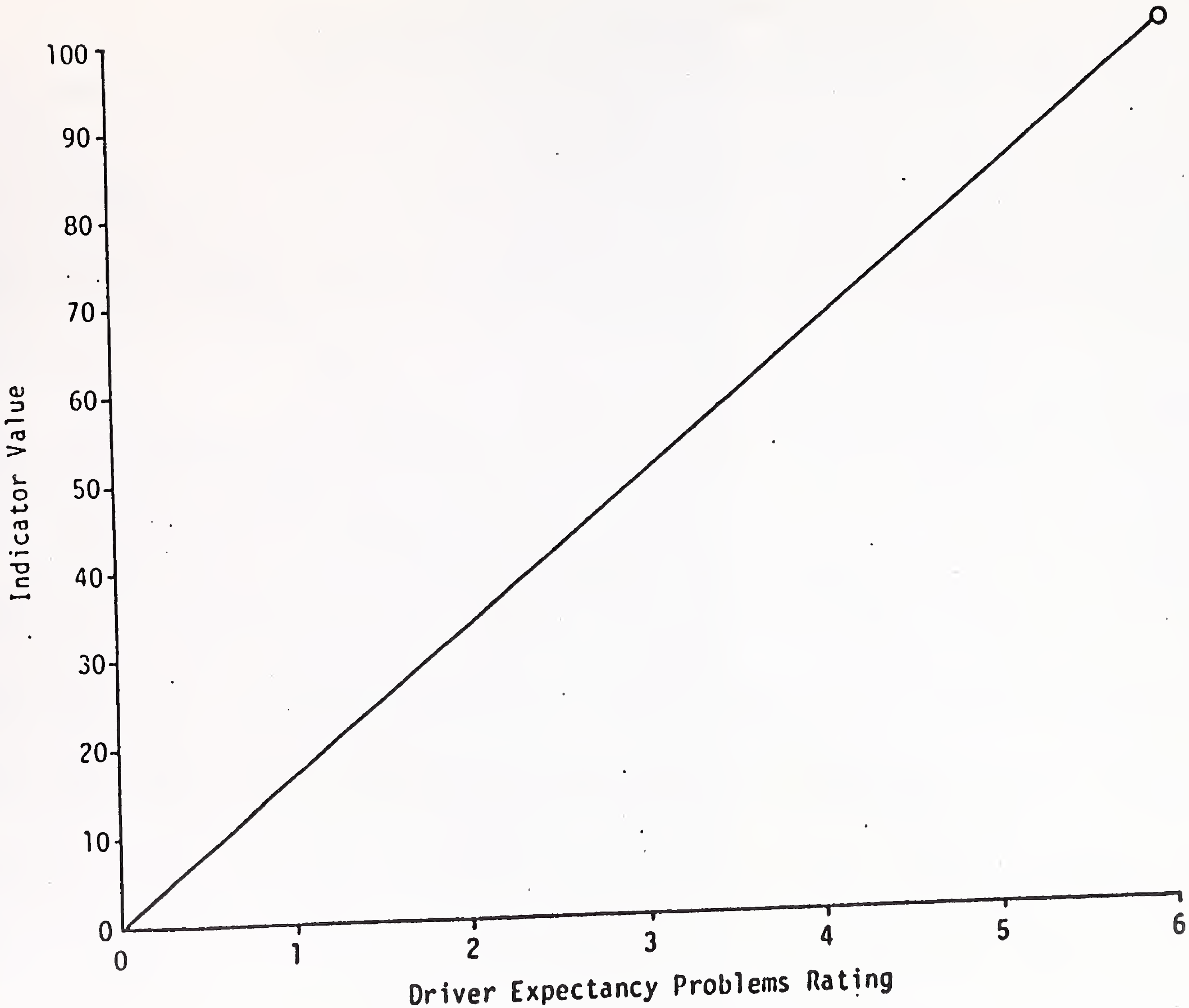


Figure 6. Indicator values for driver expectancy.

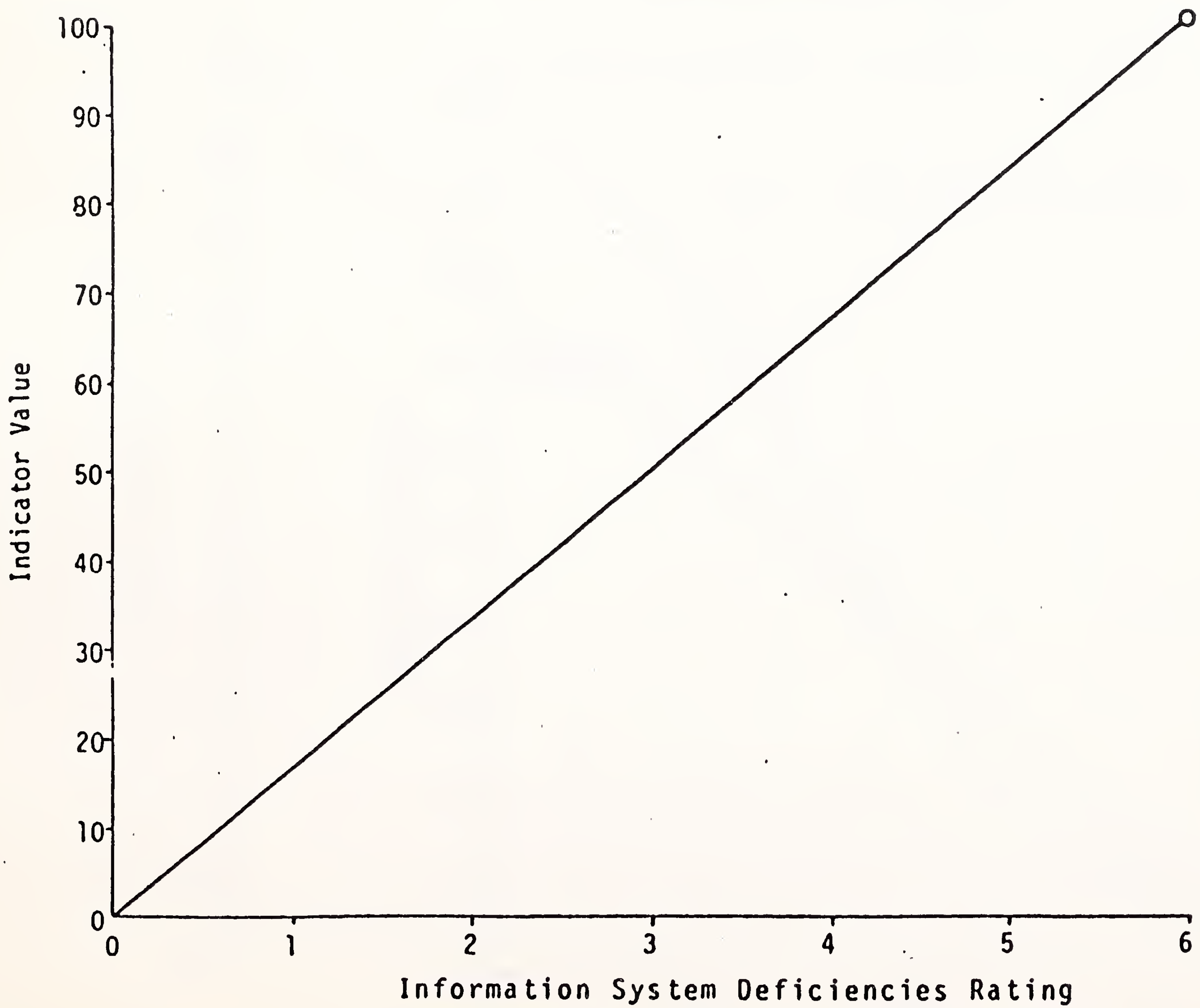


Figure 7. Indicator values for information system deficiencies.

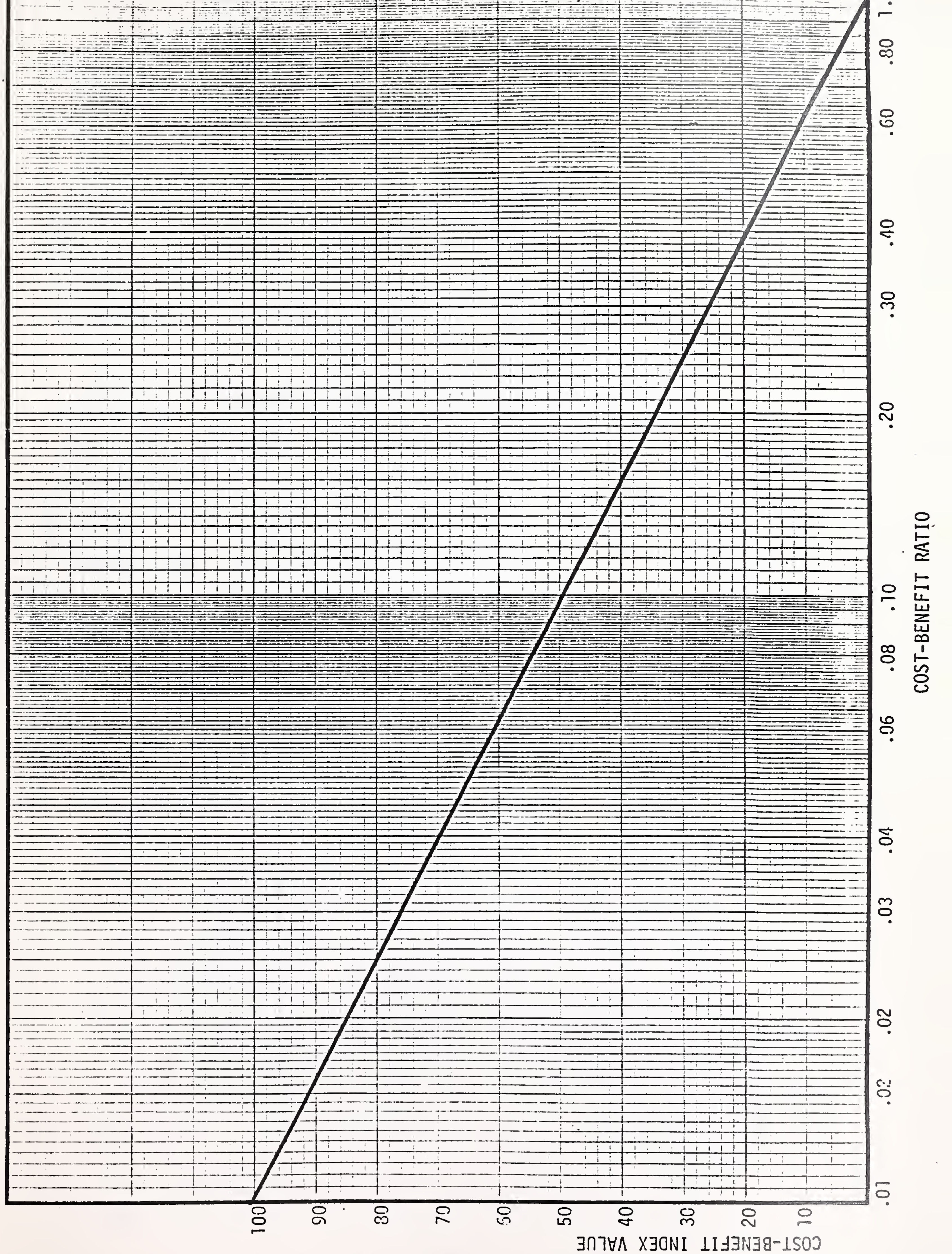

COST-BENEFIT RATIO
.01
.02
.02
.03
.04
.06
.08
.10
.20
.30
.40
.60
.80
1.
COST-BENEFIT INDEX VALUE
100
90
80
70
60
50
40
30
20
10

FIGURE 8

HAZARD INDEX RANKING

Based on the hazard analysis for each site a matrix of indicator values and final hazard index ratings was constructed and a preliminary hazard index ranking was completed. Table 3 lists this ranking by site number, location, indicator values and hazard index. Also shown is statistical information for the indicator values and hazard index.

During the process of field data collection and subsequent indicator computations, it was discovered that the two entirely subjective indicators could vary widely between consecutive analyses among non-experienced observors. Butte-Silver Bow will most likely retain traffic personnel who will update the high hazard priority list and therefore these indicators should remain as part of the hazard index ranking.

TABLE 3

PRELIMINARY HAZARD INDEX RANKING

(7 Indicators - 88.6% Strength)

RANK	SITE NO.	SITE DESCRIPTION	NO. ACCIDENTS	ACCIDENT RATE	SEVERITY	VOL./CAP.	SIGHT DISTANCE	DRIVER EXPECT.	INFO. DEFICIENT	HAZARD INDEX
			INDICATOR VALUES							
1	#12	Washington-Granite	45	67	46	16	86	75	50	55.85
2	#8	Farragut-Ottawa	42	55	44	19	87	72	58	53.08
3	#9	Excelsior-Platinum	47	40	50	28	83	78	50	52.09
4	#1	Main-Mercury	69	57	44	34	83	44	33	51.85
5	#13	Wyoming-Galena	46	56	42	19	82	62	55	51.35
6	#3	Montana-Platinum	65	34	43	46	91	50	44	49.58
7	#6	Main-Front	52	21	44	43	85	63	67	48.60
8	#2	Harrison-Cobban	68	28	44	49	91	50	38	48.47
9	#18	Utah-Platinum	41	25	47	27	92	72	62	48.23
10	#4	Harrison-George	54	21	47	46	87	67	33	46.57
11	#16	Main-Broadway	42	19	55	40	83	50	67	46.28
12	#11	Harrison-Gilman	45	16	50	35	73	62	55	44.39
13	#5	Montana-Mercury	52	26	43	36	87	50	42	44.28
14	#10	Harrison-Ottawa	47	15	44	41	78	62	55	44.22
15	#14	Harrison-'A'	46	18	44	40	83	62	45	43.86
16	#7	Farragut-Cobban	47	25	46	39	79	47	33	41.99
17	#20	Main-Second	37	21	45	26	87	55	42	41.02
18	#15	Harrison-Olympia	37	10	42	35	95	63	45	40.86
19	#17	Main-Granite	39	17	44	37	75	47	33	38.04
20	#19	Idaho-Park	39	22	42	32	84	38	33	37.71
		Average Value	48.0	29.65	45.3	34.4	84.6	58.4	47.0	46.42
		Range	37-69	10-67	42-55	16-49	73-95	38-78	33-67	37.71-55.85
		Standard Deviation	9.60	16.45	3.25	9.40	5.57	11.18	11.43	5.06

ERROR ANALYSIS

The analysis of high hazard accident sites by the methods published in FHWA Report No. FHWA-RD-77-83 intrinsically contains some degree of error due to subjective data collection and computational bias. In the application of the method, certain other innate errors appear in various forms. A cursory analysis of these error sources and the relative degree of effect each has on the final index ranking is presented in this section.

SITE SELECTION

The selection of accident sites considered for inclusion in the analysis must be accomplished according to logical criteria. The following list contains elements of site selection that must be considered in order to develop a manageable number of sites to be studied.

- Accident reports must be available for every section of road within the County's jurisdiction.
- Information on reports must be correct and complete.
- Accidents must be accurately pinpointed as to route and exact location.
- Minimum number of accident criteria must be established to select a list of sites for further review.
- The list should be narrowed further by eliminating those sites that would not exceed a minimum value of accidents per million vehicles.

If any of the above elements are missing from the site selection process of if any personal or subjective judgement is applied contrary to these elements, statistical bias is introduced into the analysis.

RANKING DISTRIBUTION

Assuming that a logical and unbiased process of selecting sites in Butte-Silver Bow was completed, those sites should be the most hazardous of all sections of all roads in the county. If a plot of the general population of all sites were made according to the hazard index values, the distribution would appear similar to that of Figure 9. The small area in the high hazard index range represents the number of sites that should be involved in the hazard study.

Figure 10 shows an actual plot of the number of sites falling within certain ranges of index numbers. Although the scales between the normal distribution and the Butte Silver Bow sites do not match, it is observed that the slope downward correlates. There were perhaps, not a statistically sufficient number of accident sites to establish a true indication of distribution, but the trends are adequate to indicate that the site selection and analysis is satisfactory.

NUMBER OF ACCIDENTS INDICATOR

The average number of accidents per year for all twenty sites was 5.0 which would result in an average indicator value of 49. Judging from the condition and maintenance of accident reporting and filing during the time of the reporting period, in which several accidents may have been either lost or identified at the wrong location, the number of accidents could have been wrong. Assuming the worst conditions for error analysis purposes, two reports may be incorrect either by misplaced location or lost which would produce negative bias. Two reports would result in 0.80 accidents per year error. The indicator value for this site would be 46 causing a negative bias of 6%.

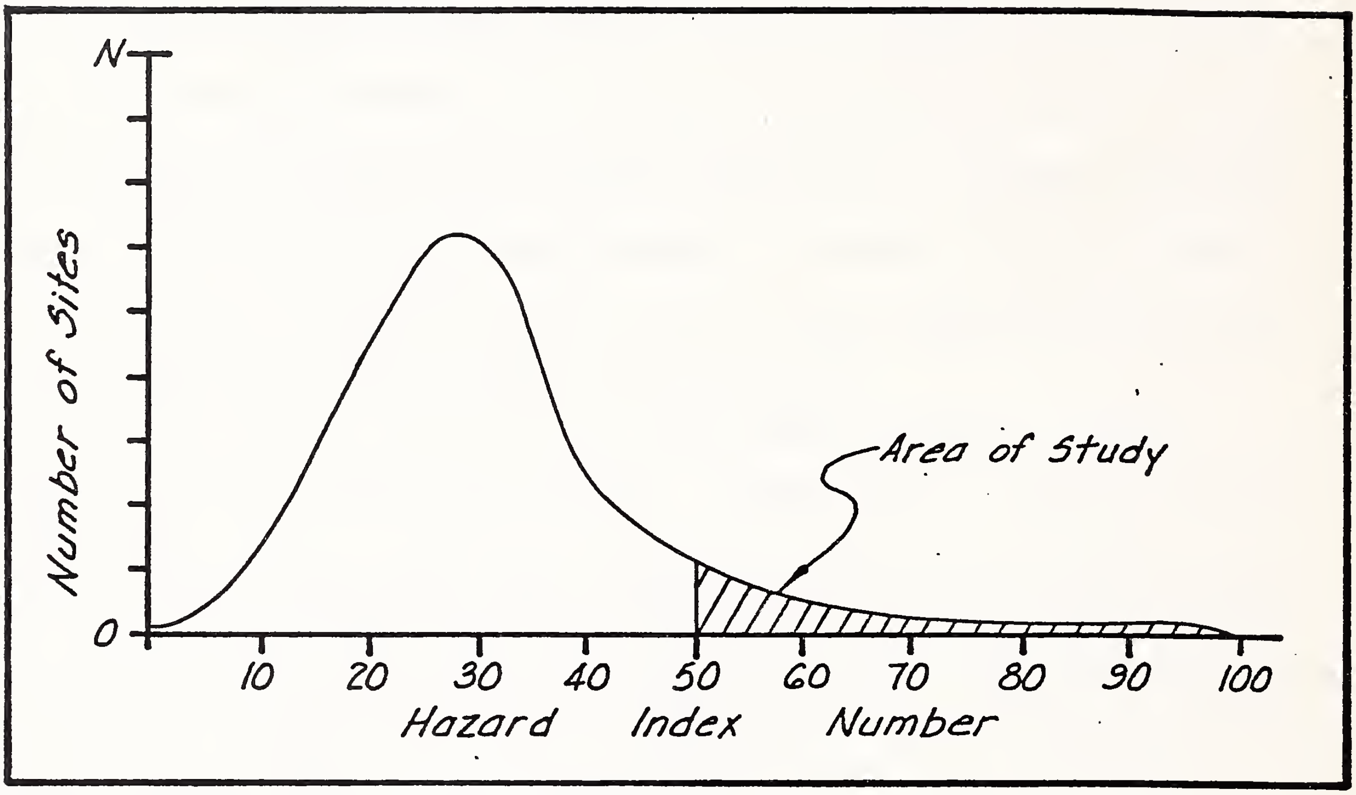


Figure 9. Normal Distribution of 'N' Number of Sites.

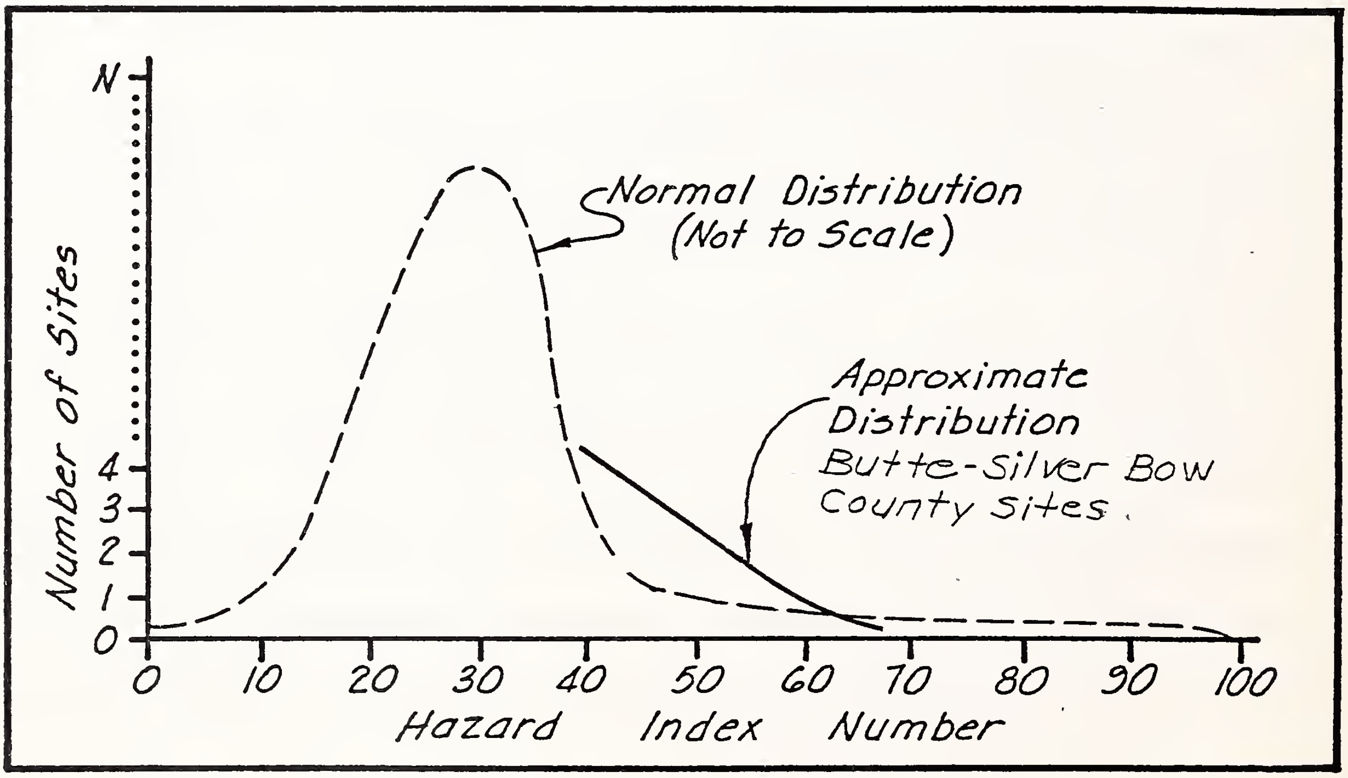


Figure 10. Distribution of Butte-Silver Bow Sites.

ACCIDENT RATE INDICATOR

Since volume data for the exact period of accident reporting may not exist at some locations, factors adjusting past or present Average Daily Traffic (ADT) to the analysis period were used. Assuming the worst cases of no growth or double growth the actual ADT during the reporting period would have been negative or positive biased. An analysis indicates the assumptions introduce a negative or positive bias of 6% in the indicator value.

The volume capacity indicator would present a similar bias of lesser magnitude due to ADT factoring.

HAZARD INDEX ERROR

Based on the foregoing assumptions the average hazard index of 47.1 could be negative biased (as the worst condition 1.18 index points). It is unlikely that all bias would be directed in a positive or negative direction. It is most probable that compensating errors occurred in the majority of instances.

PRIORITY INDEX

Table 4 represents the tabular computation method used to develop the composite hazard index - cost-benefit index values. From this computation the final priority list was developed (Table 5).

It should be noted that the priority list contains only short term improvements. Since all long term improvements are major reconstruction projects based on future conditions of volume and use, a separate priority listing for long term improvements was assembled. Priorities rankings from the long term improvements list may be inserted into the short term improvements if Butte Silver Bow determines that the magnitude of funds necessary for their implementation are available. Table 6 presents the long term improvements priority list.

TABLE 4

PRIORITY INDEX COMPUTATION

HAZARD INDEX RANK	HAZARD INDEX	C/B RATIO	C/B INDEX	PRIORITY INDEX (.67 HI + .33 CB)	PRIORITY	
					RANK	SITE
1	55.85	.1558	40	50.44	2	12
2	53.08	.3165	24	43.48	8	8
3	52.09	.2876	26	43.48	9	9
4	51.85	.1499	40	47.94	3	1
5	51.35	.0883	52	51.56	1	13
6	49.58	.1834	36	45.10	6	3
7	48.60	.2479	30	42.46	11	6
8	48.47	.1334	43	46.66	5	2
9	48.23	.3950	20	38.91	13	18
10	46.57	.1027	49	47.37	4	4
11	46.28	.1696	38	43.55	7	16
12	44.39	.3775	21	36.67	15	11
13	44.28	.1516	40	42.87	10	5
14	44.22	.3699	21	36.56	16	10
15	43.86	.2338	31	39.62	12	14
16	41.99	.3242	24	36.05	17	7
17	41.02	.4592	16	32.76	18	20
18	40.86	.2342	31	37.61	14	15
19	38.04	.3728	21	32.42	20	17
20	37.71	.3480	22	32.53	19	19

TABLE 5

PRIORITY LIST

(Short Term Improvements)

Priority		Site	Priority Index	*Estimated Cost
1	#13	Wyoming - Galena	51.56	$ 4,250
2	#12	Washington-Granite	50.44	8,050
3	#1	Main - Mercury	47.94	15,940
4	#4	Harrison - George	47.37	7,900
5	#2	Harrison - Cobban	46.66	8,610
6	#3	Montana - Platinum	45.10	13,240
7	#16	Main - Broadway	43.55	8,330
8	#8	Farragut - Ottawa	43.48	8,800
9	#9	Excelsior - Platinum	43.48	63,055
10	#5	Montana - Mercury	42.87	7,050
11	#6	Main - Front	42.46	12,070
12	#14	Harrison - 'A'	39.62	4,590
13	#18	Utah - Platinum	38.91	17,735
14	#15	Harrison - Olympia	37.61	5,050
15	#11	Harrison - Gilman	36.67	19,960
16	#10	Harrison - Ottawa	36.56	7,250
17	#7	Farragut - Cobban	36.05	14,130
18	#20	Main - Second	32.76	13,685
19	#19	Idaho - Park	32.53	6,390
20	#17	Main - Granite	32.42	9,935
		TOTAL COST SHORT TERM IMPROVEMENTS		$256,020

*Does not include: Administrative, Engineering, Replacement or Maintenance Costs.

TABLE 6

PRIORITY LIST

(Long Term Improvements)

Priority		Site	Priority Index	Estimated Cost
1	#3	Montana - Platinum	40.77	$ 140,680
2	#2	Harrison - Cobban	40.72	116,700
		TOTAL COST LONG TERM IMPROVEMENTS		$ 257,380

IMPLEMENTATION

The priority lists have been arranged in a manner that budget considerations can readily be applied in the decision to proceed with improvements. The priority ranking should be the major consideration in selecting which sites will be receiving funds first. However, when limited funds are available it may be wise to skip over one or two projects to improve a greater number of sites.

As an example, Butte-Silver Bow may budget $38,000 the first year. It would be logical to proceed through the priority list totaling project costs. By the time priority Site 4 was included, the total would be $36,140. If priority Site 5 were added the total would exceed the budget by $6,750. Rather than underspend the budget, priority Site 4 could be skipped and priority Sites 5 and 7 could be completed that year. The following year, priority Site 4 would become priority Site 1 and 6 would become priority Site 2, and the same budget procedure used to work through the list.

STUDY CHARACTERISTICS

Various traffic characteristics are prevalent among regions of the United States. Characteristics may also vary between states, cities, counties, and between lesser finite areas depending on the type of characteristics examined. As part of any traffic study with the objectives of identifying hazardous sites to improve safety or efficiency of the traffic carrying system, it is important to know the characteristics of traffic flow, driver behavior, and other factors affecting traffic operations. Therefore as an integrated part of this study, the distinct characteristics of the Butte-Silver Bow area were incorporated in the analysis of accidents and subsequent recommendations for improvements.

Traffic Volumes

All available data that had been assembled by the Montana Department of Highways was examined and interpreted to provide annual Average Daily Traffic (ADT) expansion factors. In addition to this data, 24-hour automatic counters were set out at all of the high hazard sites to provide current ADT as well as provide hourly variation factors. Turning movement counts were taken for the most part at peak evening and morning hours and in some cases during more normal operational periods of the day. The turning counts prove invaluable in detecting improper geometrics for turning volume conditions and also provide a basis on which to modify signal timing and progression.

Since no currently published study had presented 24-hour graphic plots of traffic volume variations, it was felt necessary to develop these curves and present them within this report. Figures 11 through 16 are plots of hourly traffic variations expressed as a percentage of 24-hour traffic for representative streets in the Butte urban area.

System Characteristics

It was observed during the course of the study, that the urban area of Butte-Silver Bow contains a heterogeneous mixture of modern state of the art traffic control devices and various control measures that have been outdated for some time. For the most part, the entire area is devoid of signing and pavement markings. Areas which do provide a degree of modern signing and pavement marking are often deficient in one or more aspects of standards as presented in the Manual of Uniform Traffic Control Devices (MTCD). The non-uniformity of traffic control devices is a serious problem and can be a major contributor to accidents since driver expectancy is violated.

The street systems within the City proper have been aligned and constructed since the turn of the century. Narrower streets, sandwiched between multi-story buildings in the uptown area present on a reduced scale, all of the turning movement and vehicular-pedestrian conflicts of larger metropolitan cities.

Streets constructed in an area commonly known as the "Flats" follow a more conventional alignment than the CBD area. However, pertinent road structures, particularly curb and gutter which are considered necessities in most urban areas, are seriously lacking. Curb and gutter which provide positive drainage and protects the subbase structure, also is a valuable traffic control device. Barrier curb systems, not only delineates the edge of the road but also provides a means of controlling approach traffic onto the traveled street section.

Of particular concern within the City of Butte is the problem of parking. At almost every site, parking characteristics played a major role in creating site distance restrictions which were contributory to numerous accidents. The wide spread practice of double parking in the driving lane, particularly

in the uptown or Central Business District of Butte, presents serious operational and traffic safety problems. Historically, the problem had existed in Butte for a number of years. It is not known whether enforcement policies have ever resulted in any degree of improvement. It is apparent that the parking problems are sufficient to justify a parking study within the city to determine the adequacy of available parking in the CBD. Commercial deliveries seem to create the most significant problems. The sites where double parking violations were observed are: Site 1 (Mercury), Site 3 (Platinum) Site 13 (Wyoming), Site 15 (Olympia), Site 16 (Main & Broadway), and Site 17 (Main and Granite). If local knowledge of specific problem areas can be obtained, perhaps commercial loading zones or other methods of parking control can be initiated at some locations.

Driver Characteristics

The safe and efficient operation of any street system is heavily dependent upon the characteristics of the drivers using the facilities. It was observed during the course of the study that an overall violation of traffic laws occur in significant proportions. It is believed that the driver behavior is directly influenced by the character of the street systems within Butte. The unfamiliarity of area drivers with standard traffic control devices is evident. More widespread and uniform use of modern standard traffic control devices along with an aggressive enforcement program will undoubtedly improve driver behavior over a period of years.

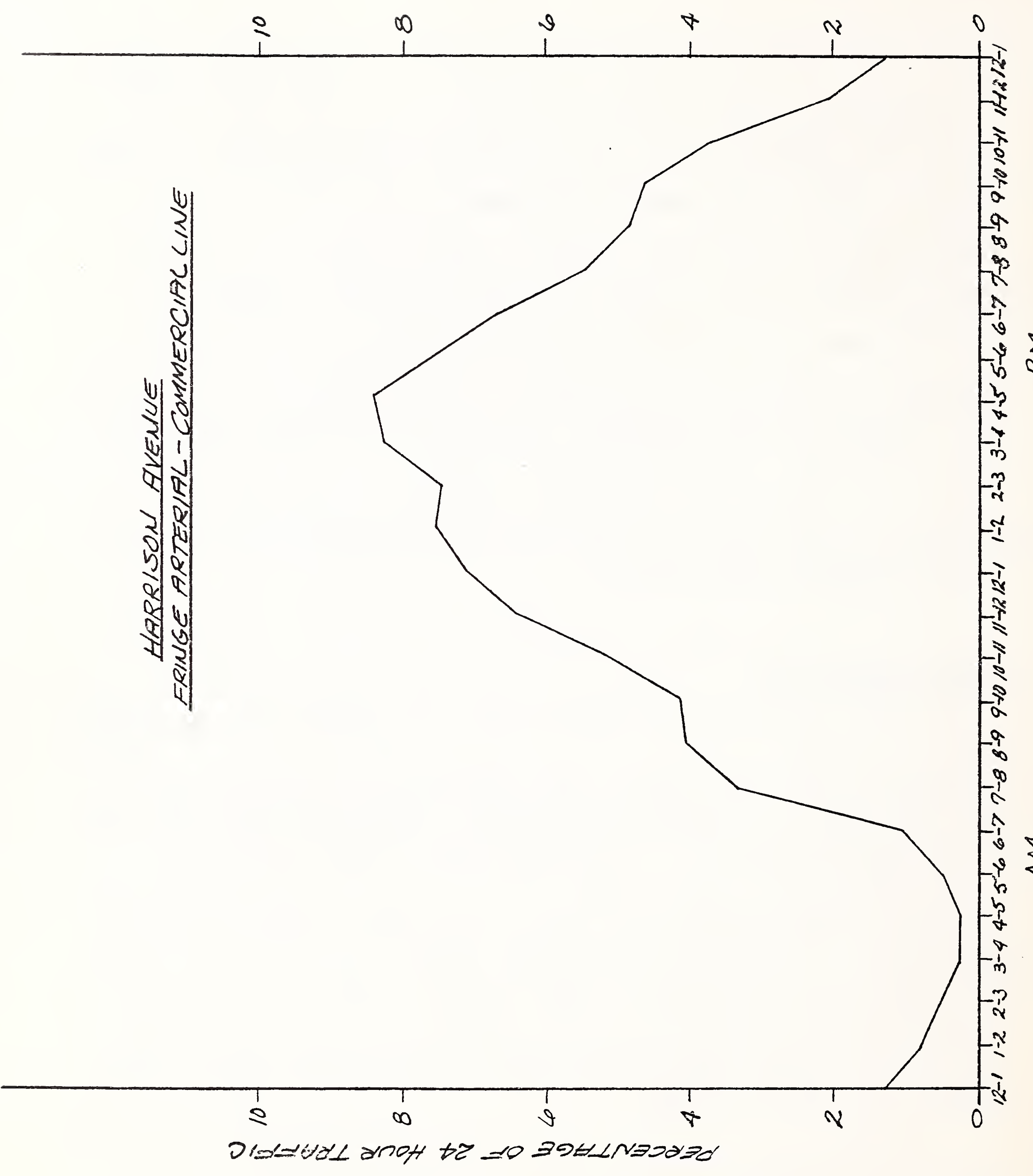


Figure 11. 24-Hour Traffic Volume Variations

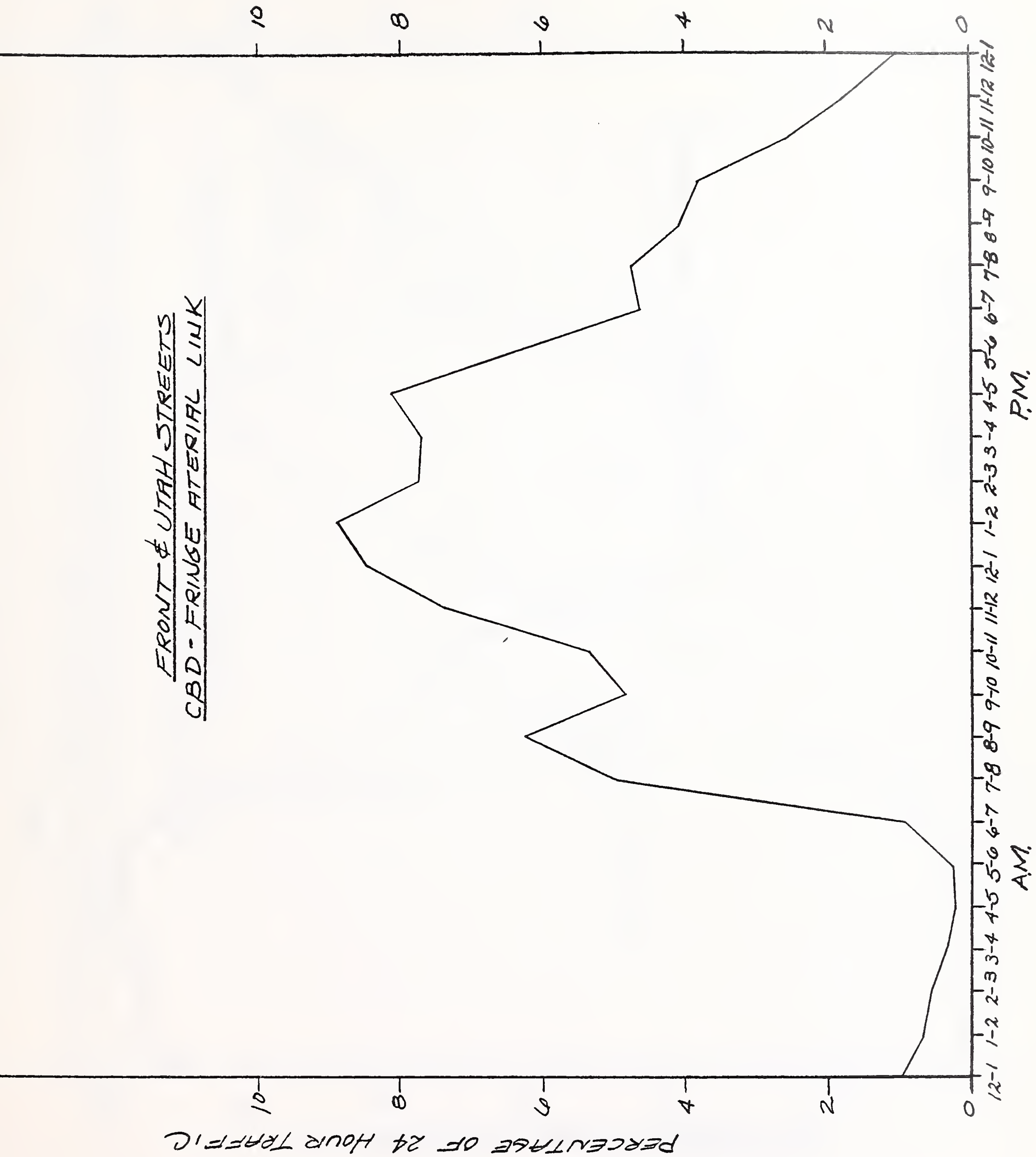


Figure 12. 24-Hour Traffic Volume Variations

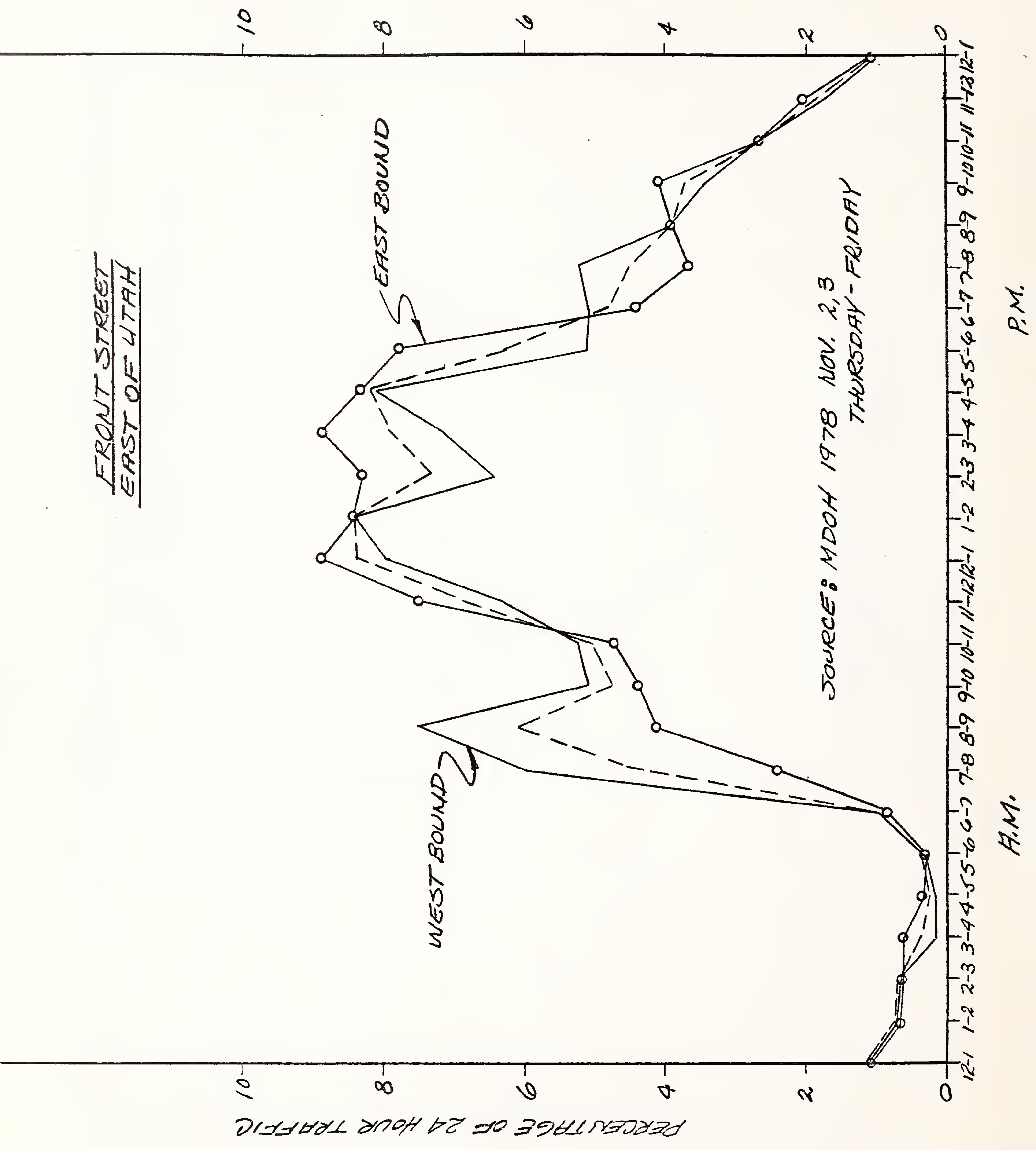


Figure 13. 24-Hour Traffic Volume Variations

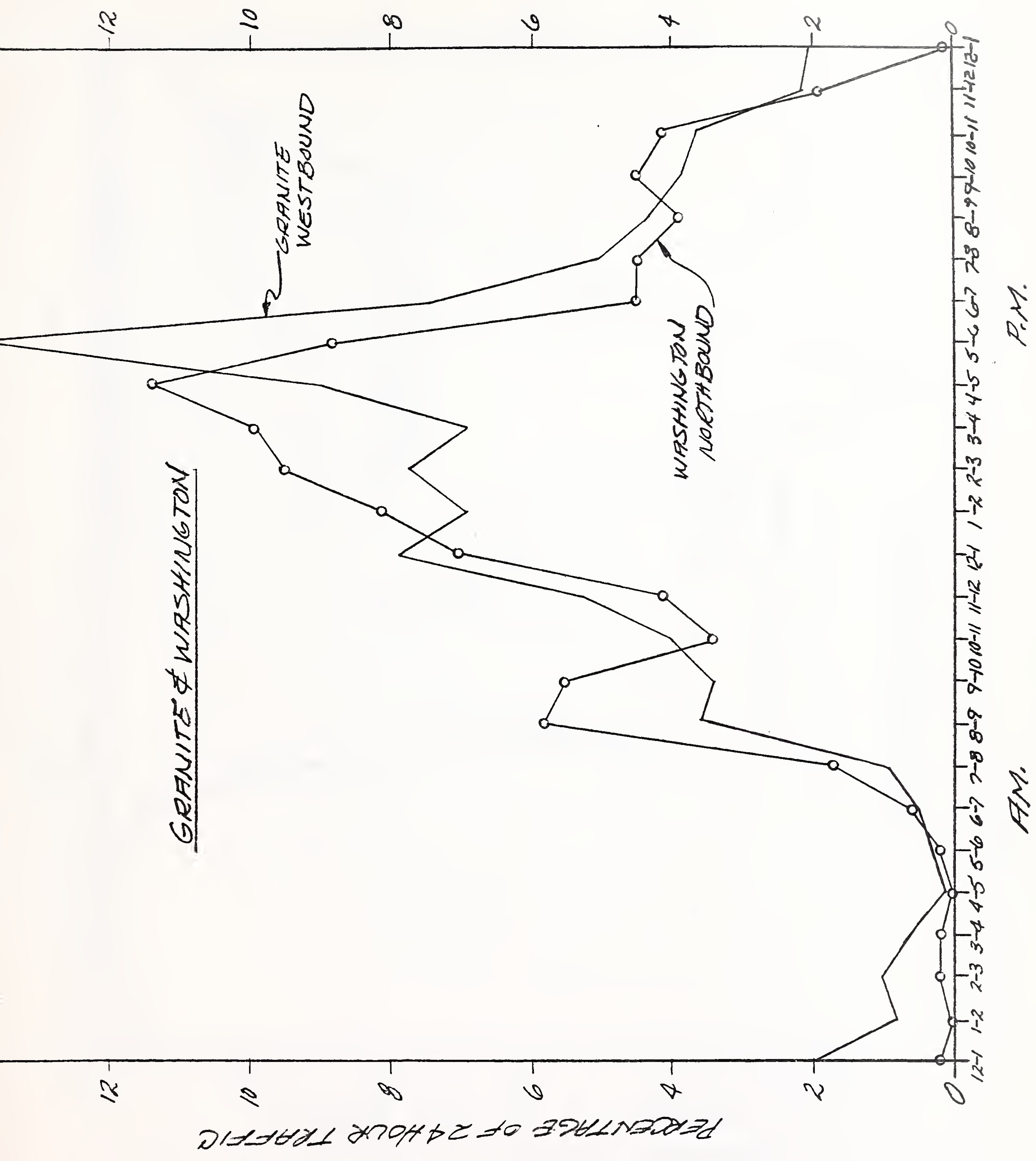


Figure 14. 24-Hour Traffic Volume Variations

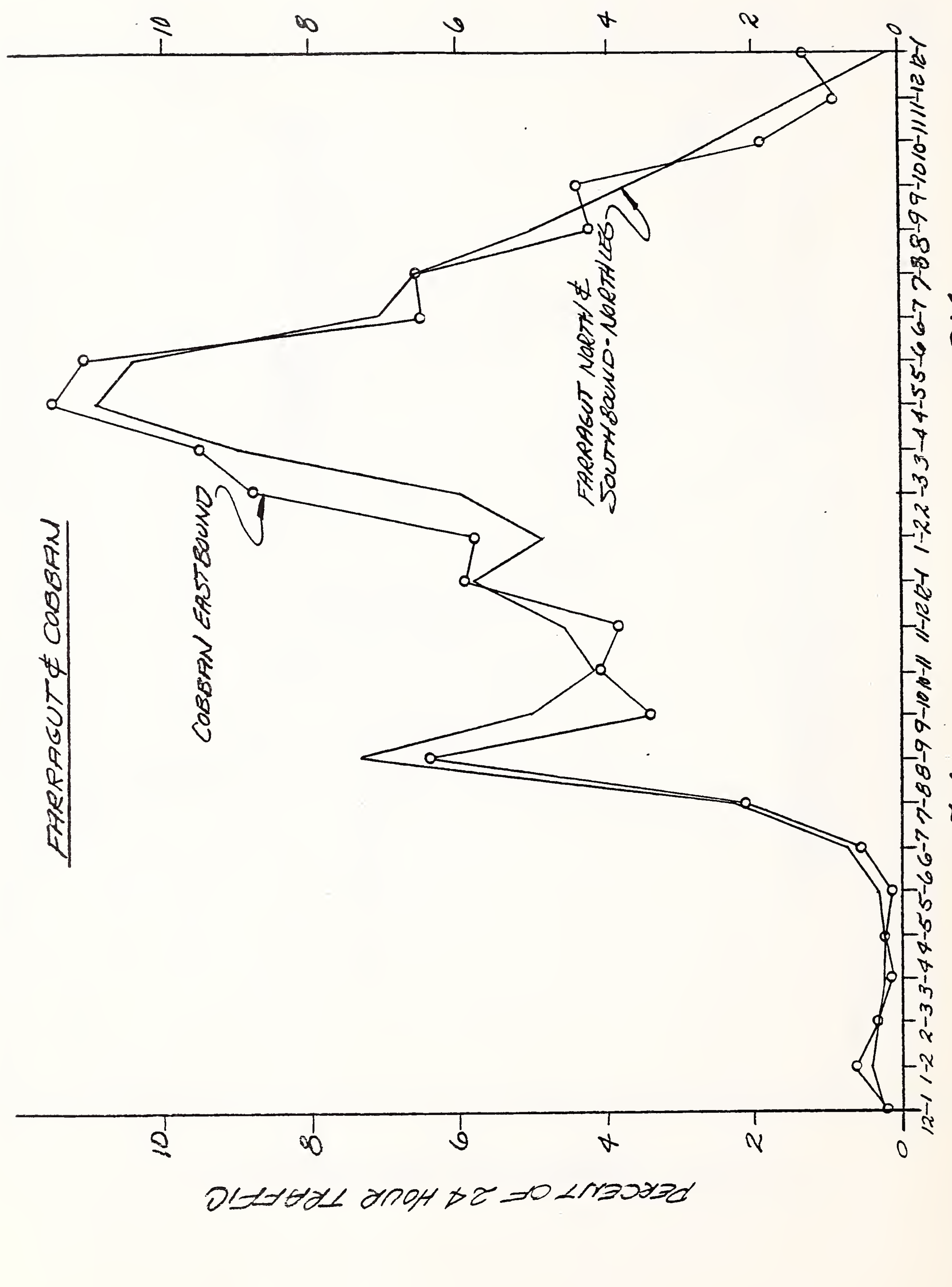


Figure 15. 24-Hour Traffic Volume Variations

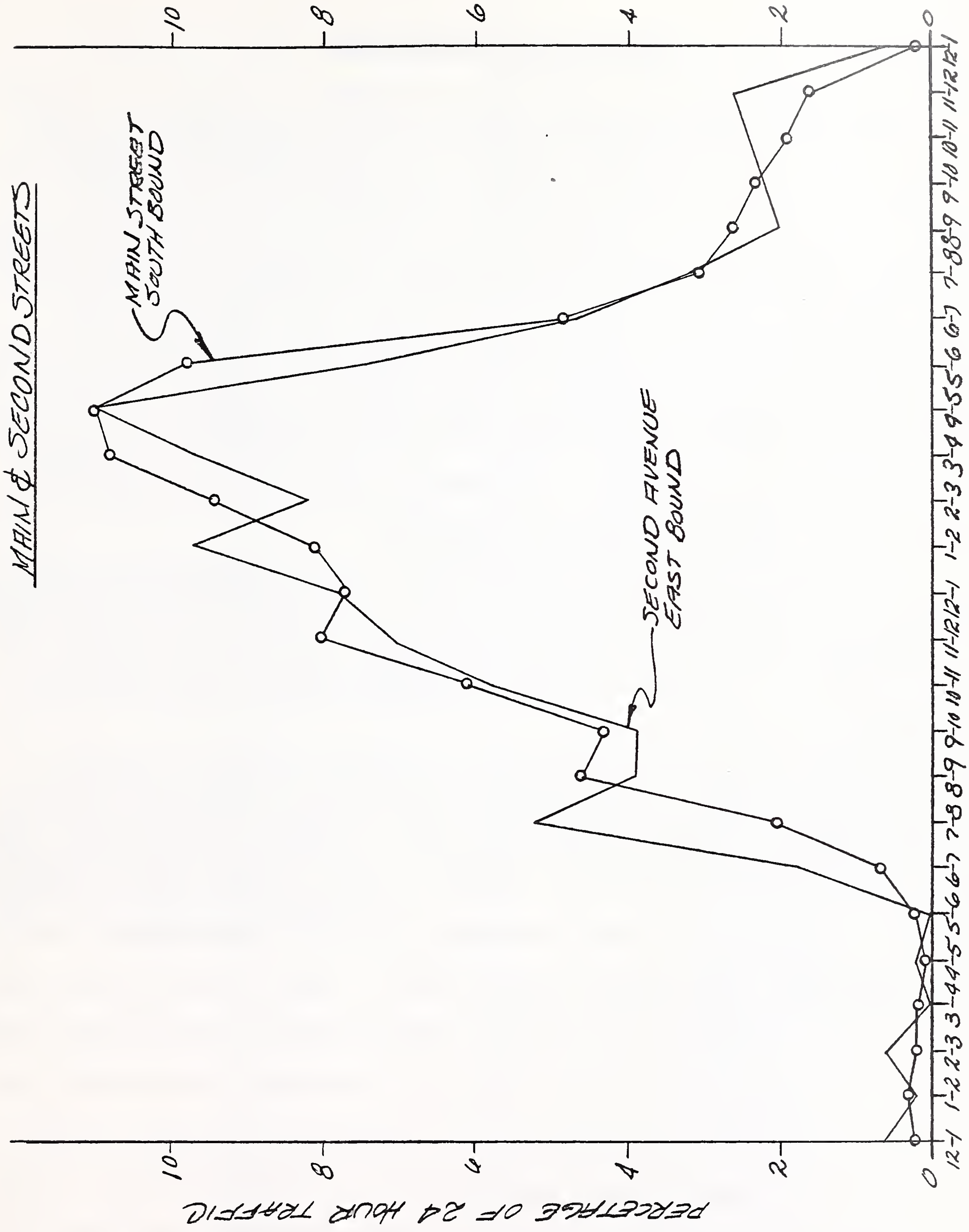


Figure 16. 24-Hour Traffic Volume Variations

EXPLANATION OF IMPROVEMENTS

The recommended improvements presented within this report are of two types. Short term improvements indicate the minimum amount of upgrading or modifications necessary to increase driver expectancy and to update the site to current standards. Long term improvements are normally considered viable when severe conditions at the site prevent short term improvements from completely satisfying the control measures necessary to prevent future problems. Many of the recommended improvements have sufficient latitude so that alternative measures can be suggested. The selection of alternative improvements were based on subjective engineering judgement.

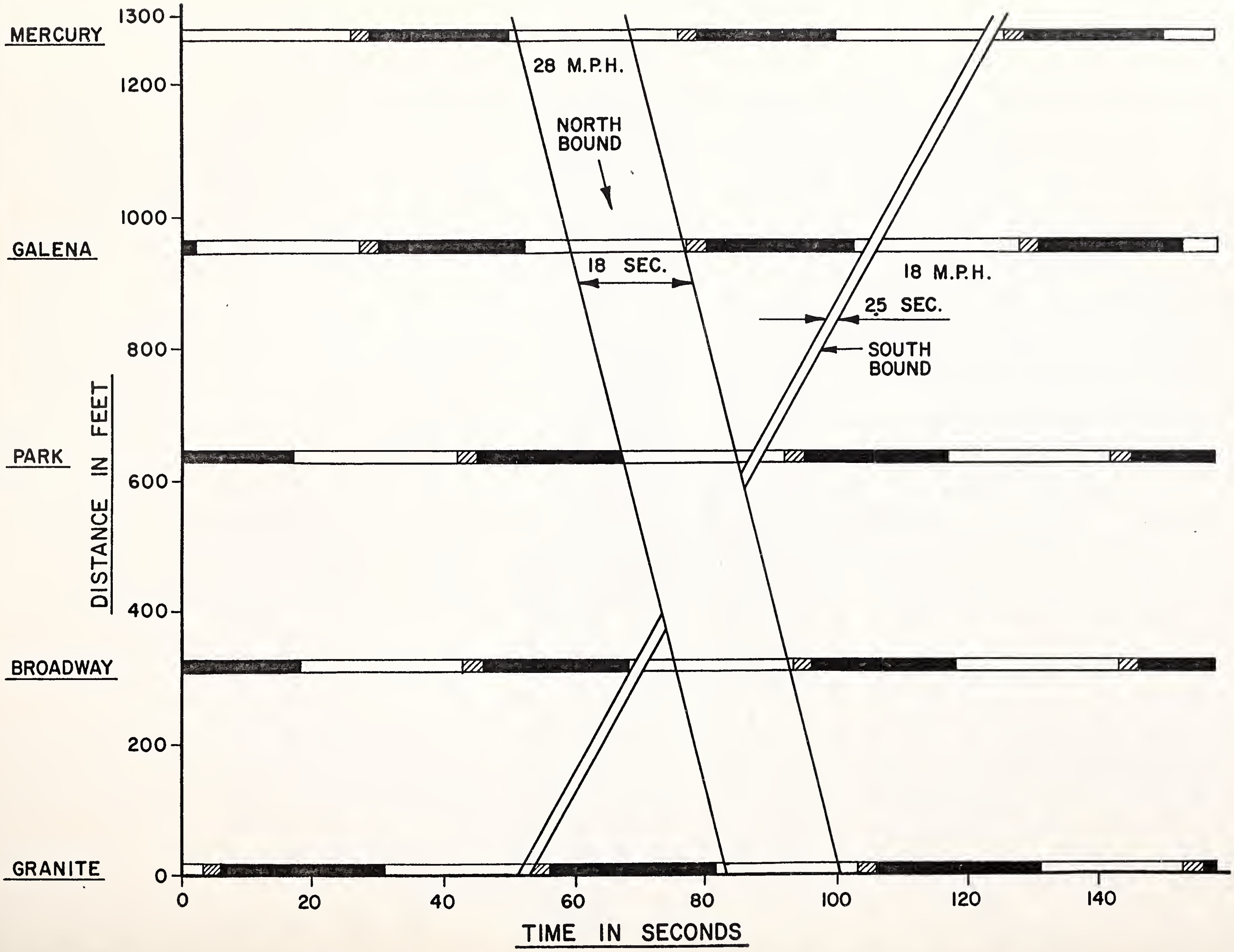
At numerous sites it was noted that many traffic control devices were not in compliance with MUTCD. There were also several locations where there were operational or maintenance problems with signal systems, which should be immediately repaired.

In many instances the improvement recommendations include the use of plastic overlay striping. Plastic striping is seemingly very much more expensive than the use of painted stripes. However, in high traffic areas the replacement cost of painted stripes makes the economic difference approximately zero since the replacement factor ranges between 5 and 10. Also the use of plastic overlay striping ensures that the pavement marking visibility is continued through its life whereas the use of paint is subject to periods of obliteration due to delay in maintenance operations. It is suggested that plastic pavement markings be the asphaltic tack coat variety which provides at least 1/16 of an inch reflectorized material such as the type supplied by the "PRISMO" Co.

In almost all cases the recommended improvements will require precise layout in the field. In addition an experienced traffic engineer is required to coordinate other phases of the recommended improvements.

In addition to the improvements outlined in each site analysis, one specific problem involving all of the intersection sites on Main Street exists. The Figure 17 on the following page is a time space diagram illustrating the existing progression on Main Street. As can be seen northbound traffic has a progression velocity of 28 mph which is entirely too fast for existing conditions. Southbound progression velocity is 18 mph which is slightly slow although adequate for peak hour traffic. In addition, the band width is only 2.5 seconds which is insufficient for driver reactions. Since the intersections have varying cycle splits, the progression speed and band widths also vary with an undefined frequency. The net result of this progression is driver irritation and misjudgement.

Figure 18 represents a double alternate progression which is one possible progression system that could be used on Main Street. Cross street progression which would involve the entire CBD grid system, should be considered prior to settling on any one progression.



TIME SPACE DIAGRAM EXISTING MAIN STREET SIGNAL PROGRESSION

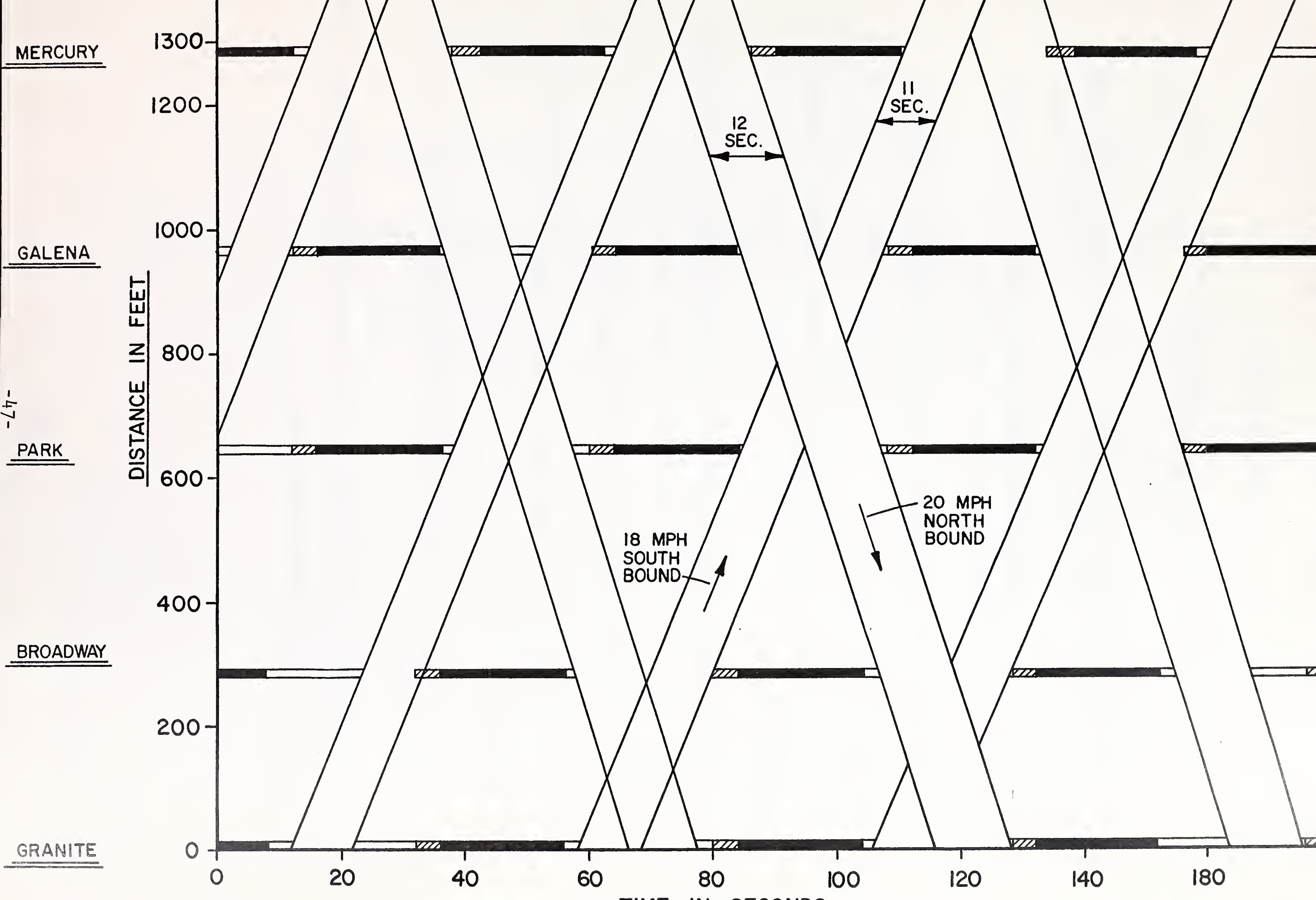


Figure 18. TIME SPACE DIAGRAM - DOUBLE ALTERNATE PROGRESSION

PROGRAM CONTINUATION

Since the basic format of the study has been outlined and an initial priority list established, continuance of the program is strongly advised. The findings and recommendations of this study will soon become obsolete without continued updating at least on an annual basis.

The following recommendations in the continuance of the program are offered to Butte Silver Bow:

1. The Police Department should continue to be assessed for copies of accident reports.

2. One person should be assessed with the responsibility of the program to insure that all data is being supplied, processed and filed.

3. An accident cluster map should be maintained.

4. Criteria should be developed for the inclusion of additional sites to be analyzed.

5. Coordinate any traffic counting programs that may exist or establish a counting program.

6. Analyze new sites according to the procedures of this study and include them in the priority list when warranted.

SITE LOCATIONS

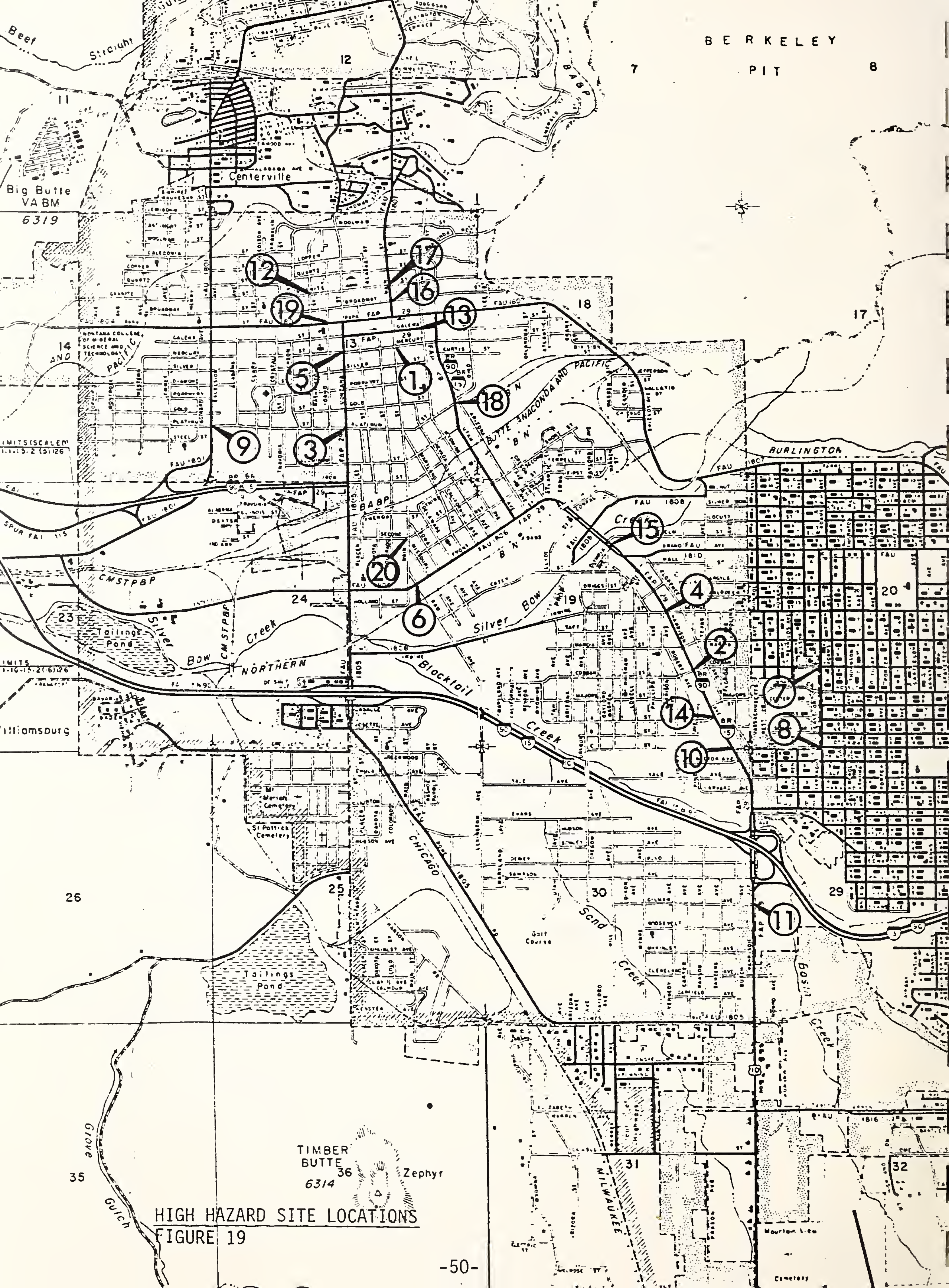
The map on the following page indicate the site numbers at their respective locations.

The site by site analysis immediately follows this section of the report. Each site is separated by a tabbed index for ease of reference.

The following is a list of site numbers for reference to the map:

HIGH HAZARD INTERSECTION LOCATIONS

1. Main - Mercury
2. Harrison - Cobban
3. Montana - Platinum
4. Harrison - George
5. Montana - Mercury
6. Front - Main
7. Farragut - Cobban
8. Farragut - Ottawa
9. Excelsior - Platinum
10. Harrison - Ottawa
11. Harrison - Gilman
12. Granite - Washington
13. Galena - Wyoming
14. Harrison - 'A'
15. Harrison - Olympia
16. Main - Broadway
17. Main - Granite
18. Utah - Platinum
19. Park - Idaho
20. Main - Second



HIGH HAZARD SITE LOCATIONS
FIGURE 19

SITE 1

SITE NUMBER 1

MAIN STREET - MERCURY STREET

LOCATION DESCRIPTION

The intersection of Main and Mercury is located in the central business district of uptown Butte. Main Street is a north-south arterial street and Mercury is an east-west collector. The intersection serves the type of traffic characteristic to the area, ie. commercial delivery, commutor, and shopping traffic.

EXISTING CONDITIONS

Geometrics. The Existing Condition Sketch illustrates all of the topographic features of the intersection area. The approach grades on Main Street are extreme to the south while the approach grades on Mercury are mild. All four corners of the intersection have existing buildings with sidewalks and curb sections on all approach legs.

Signalization. The intersection is signalized and is part of a north-south signal progression system (see page 45 of this report). The signal controller at this intersection is an Econolite Solid state, fixed-time controller. The total cycle is 50 seconds with Main receiving 26 seconds green and Mercury receiving 16 seconds green. Ambers on both Main and Mercury are 4.0 seconds.

Signing. The only signing at the intersection is non-standard or not applicable, except for a parking restriction sign and a truck route sign.

Pavement Markings. Pavement striping appears to be standard, however the pavement markings were badly worn and for the most part not visible under normal

driving conditions.

Traffic Volumes. The Turning Movement Summary shown on the following page is a 4-5 P.M. peak count. Average Daily Traffic (ADT) expansion of this count produced a north-south entering ADT of 6,740 and an east-west entering ADT of 2,510. Montana Department of Highways 1978 counts shown an ADT for Main Street traffic of 6,780, which correlates well with 1979 machine counts and peak hour expansion counts.

Traffic Operation. Site distance on all approach legs is severely restricted due to the proximity of the surrounding buidlings. It is also noted that south side of Mercury Street on the east bound approach leg becomes very congested due to numerous incidents of double parking along that side of the street. Apparently a takeout restaurant at that location generates a volume of traffic that existing parking cannot handle.

ACCIDENT ANALYSIS

Over the two and one-half year period from 1977 through June of 1979, there were 26 accidents reported. There was a predominance of angle accidents and rear-end type accidents at this location. Left-turn accident occurrence was moderate. Other accidents involved maneuvers in and out of parking spaces. The majority of accidents occurred in clear weather on dry roads during the daylight hours.

It is unusual to have such a large percentage of angle accidents at a signalized intersection especially under conditions of moderate volume and low approach speeds. It is felt that the reason for this occurrence is due to a combination of conditions:

1. There is no indication whether Main Street or Mercury Street are four-lane or two-lane roadways since no information on lane designation is provided.

GRAPHIC SUMMARY OF VEHICLE MOVEMENTS

Observer *Ken Behling* Date *11/14/79* Day *Wednesday*

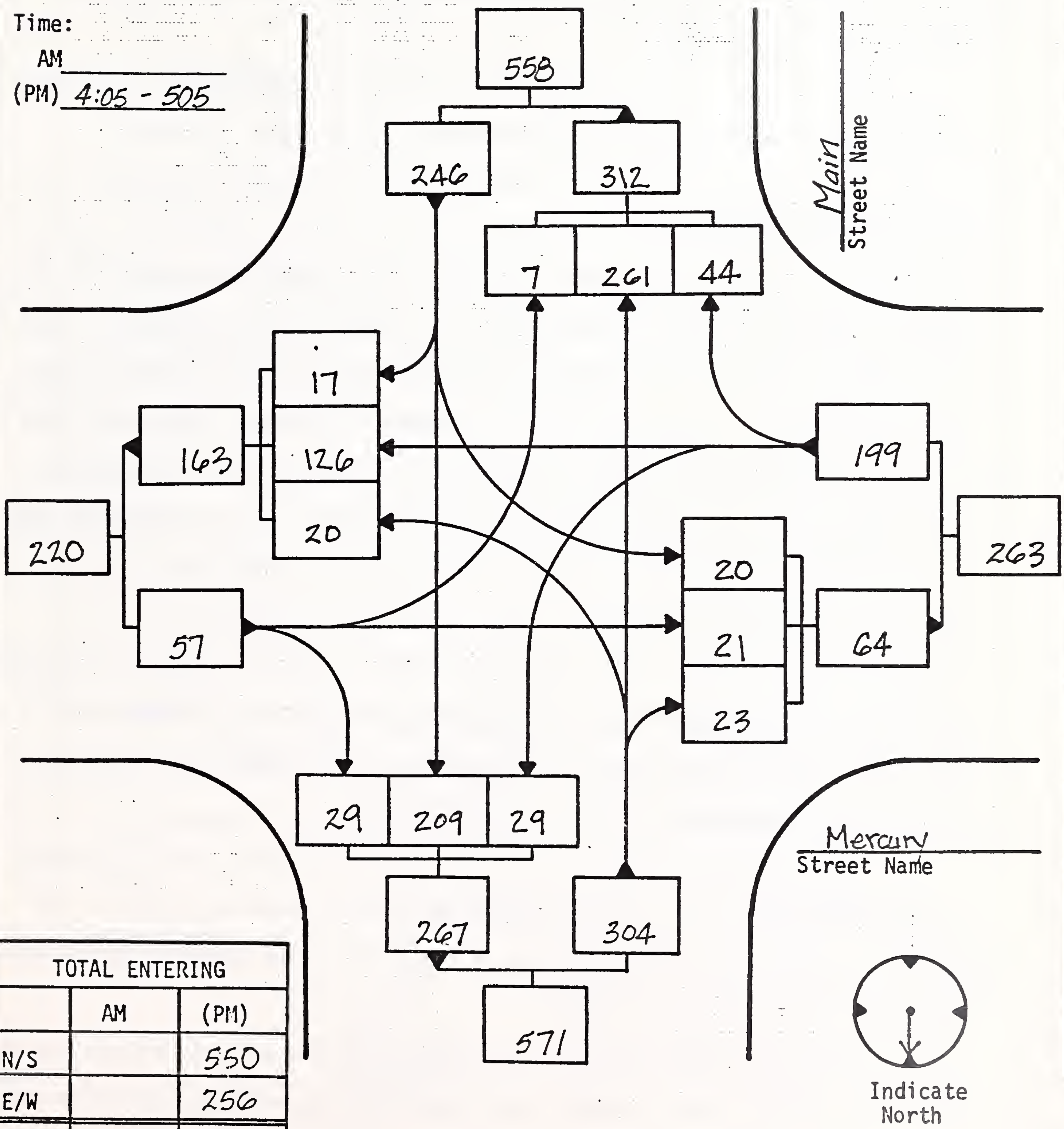
Intersection of *Main* and *Mercury*

City *Butte Montana*

Time:

AM

(PM) *4:05 - 505*



TOTAL ENTERING		
	AM	(PM)
N/S		550
E/W		256
Total		806

CSSA Traffic Form 104

Therefore, the location of approach vehicles transverse to the roadway can vary greatly. The sight distance of turning vehicles and straight through vehicles can be readily obscured.

2. Approach grades on Main Street contribute to a reduction in visibility of the signal heads due to the increased angle of the signal heads relative to the drivers line of vision.

3. The poor progression timing of north-south signals creates a forced flow situation which causes erratic approach speeds.

SHORT TERM IMPROVEMENTS

From the analysis of accidents and the existing conditions stated in the previous paragraphs, several short term improvements can be recommended. The Short Term Improvement Sketch indicates the recommended improvements which include signal adjustment, striping, and signing. Major features of these improvements are:

1. Due to the combination of street width, traffic volume and parking requirements along both Main Street and Mercury Street, it is recommended that either a painted median with left-turn bays at midblock approaches and intersections or a continuous left-turn lane be provided on both Main Street and Mercury Street. The Short Term Improvement Sketch indicates continuous left turn on Mercury with painted median left-turn bays on Main Street. However a more definitive study will be necessary to determine if the number and function of midblock approaches would require this designation.

2. The replacement of Main Street 8" red signal lenses with 12" lenses on the mast mounted signal heads will be required to increase visibility for approach traffic. Also the signal heads should be angled downward approximately 10 degrees to increase visibility.

3. The striping of parking lanes and restrictions as shown on the sketch should be made to prevent parking near the curb return radius on all intersection corners. (Refer to the Montana Motor Vehicle Code for distances).

4. The signal cycle should be retimed and synchronized with a new progression system on Main Street for both north and south bound traffic (see page 47 of this report).

5. Non-standard signs should be removed and replaced as shown on the sketch.

LONG TERM IMPROVEMENTS

The relative stability of the uptown Butte area precludes the forecast of any significant changes in traffic volume or directional distribution of existing traffic. Therefore the improvements outlined as short term are sufficient under present and expected operating conditions. Unless accepted standards of signalization, pavement markings, and signing would drastically change or the function of the entire uptown transportation grid system were to change, no long term improvements could be recommended. It is suggested however, that future maintenance of the intersection and roadways along with enforcement of applicable ordinances and laws be geared toward the efficient use of the improvements as outlined.

ECONOMIC BENEFITS

The anticipated accident reductions and related benefits derived from the recommended improvements are calculated below. The method of computation and forecasting accident reduction is detailed in the "Study Methodology" section of this report.

IMPROVEMENTS	ACCIDENTS		REDUCTION	
Short Term:	Type	% of Total	% of Type	% of All Accidents
	Angle	34	60	20
	Rear-End	19	50	10
	Side-Swipe	15	80	12
	Parked Car	4	50	2
	Left-Turn	15	50	8
	Total % Reduction of All Accidents			52

BENEFITS (Dollar Values)

(% Reduction) x (Accidents/Year) x (Useful Project Life) x (Average Severity)

Short Term: (0.52) x (10.4) x (5) x (3,933) = $106,350

PRELIMINARY COST ESTIMATE

Short Term Improvements

Item	Quantity	Unit	Unit Price	Cost
Plastic Overlay Pavement Markings	8,800	L.F.	$ 1.75	$15,400
Replace & Adjust 8" lenses with 12" Lenses	2	ea.	$175.00	350
Remove Signs	2	ea.	$ 20.00	40
Miscellaneous Signal Adjustments	1	L.S.	$150.00	150
		*Total Cost Short Term Improvements		$15,940

*Costs do not include administrative or engineering costs.

COST BENEFIT RATIO

The cost benefit ratio for Site Number 1, Short Term Improvements is calculated as follows (assuming a 5-year life of the improvements with no replacement costs on the plastic pavement markings):

Cost $/Benefit $ = $15,940/$106,350 = .1499

ACCIDENT SUMMARY

SITE NUMBER 1 LOCATION Main & Mercury REPORTING PERIOD November 19, 1979

NUMBERS OF ACCIDENTS

MONTH	NO.
JAN.	2
FEB.	6
MARCH	4
APRIL	2
MAY	
JUNE	2
JULY	3
AUGUST	2
SEPT.	2
OCT.	1
NOV.	
DEC.	2

DAY OF WK.	NO.
SUN.	4
MON.	2
TUES.	2
WED.	6
THUR.	2
FRI.	6
SAT.	4

WEATHER	NO.
CLEAR	22
RAIN	
SNOW	4
FOG	
OTHER	

ROAD CONDITION	NO.
DRY	13
WET	5
SNOWY	1
ICY	7
OTHER	

LIGHT CONDITION	NO.
DAY	15
DAWN OR DUSK	1
DARK LIGHTED	10
DARK UN-LIGHTED	

ACCIDENT TYPE	NO.
ANGLE	9
LEFT TURN	4
REAR END	5
HEAD ON	
SIDE SWIPE	4
PARKED VEHICLE	1
BACKING	1
FIXED OBJECT	1
PED.	1
ANIMAL	

YEAR & SEVERITY	NO.
1977 FATAL	
INJURY	2
PROPERTY DAMAGE ONLY	8
1978 FATAL	
INJURY	1
PROPERTY DAMAGE ONLY	11
1979 FATAL	
INJURY	
PROPERTY DAMAGE ONLY	4

HAZARD INDEX

BASIC COMPUTATIONS

Site Number 1 Date November 19, 1979

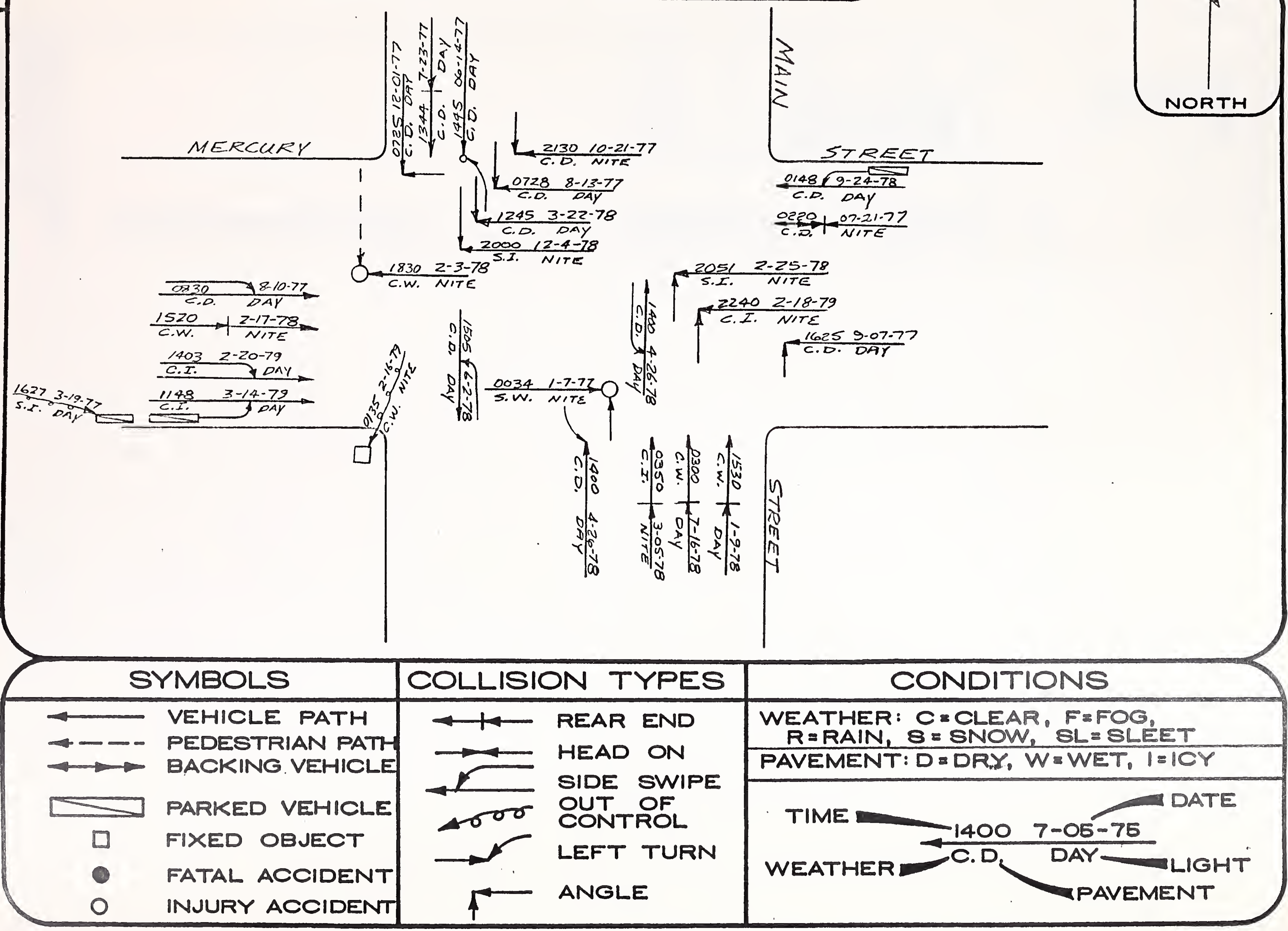
Description Main and Mercury

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	10.4 acc/yr	69	x	0.145	=	10.00
Accident Rate	2.97 acc/MEV	57	x	0.199	=	11.34
Accident Severity	3,933 dollars	44	x	0.169	=	7.44
Volume/Capacity Ratio	0.17	34	x	0.073	=	2.48
Sight Distance Ratio	0.37 (wt.avg.)	83	x	0.066	=	5.48
Driver Expectancy	2.66 (wt.avg.)	44	x	0.132	=	5.81
Info. System Deficiencies	2.00 (wt.avg.)	33	x	0.102	=	3.37
		SUMS:		0.886*		45.94

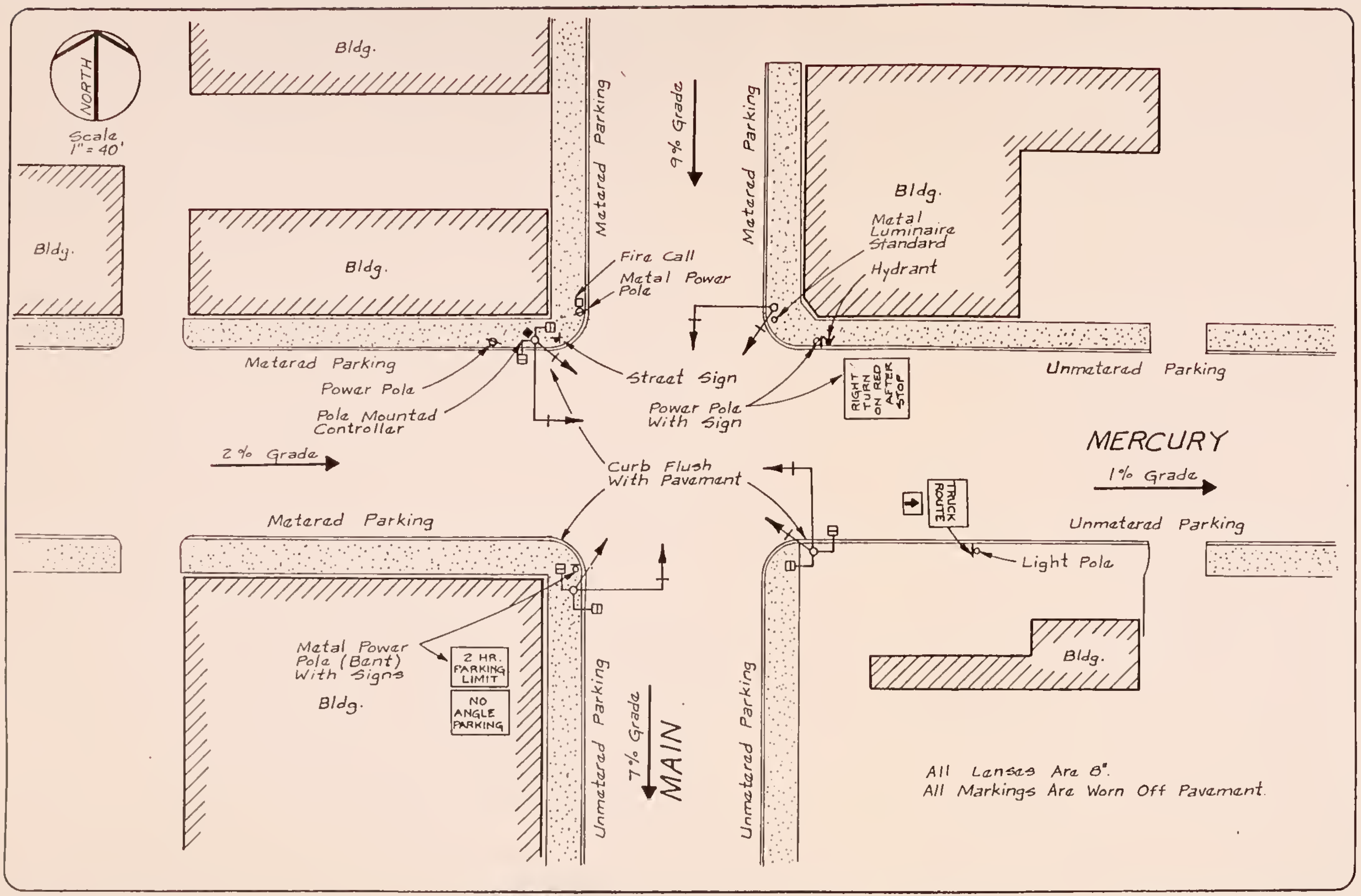
$$\text{H.I.} = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{45.94}{0.886} = 51.85$$

* The "Erratic Maneuvers" and "Traffic Conflict" indices were omitted from this study. Therefore the weight factors do not total 1.00 and all sites will be ranked on an 88.6% strength of evaluation relative to the FHWA Method.

COLLISION DIAGRAM



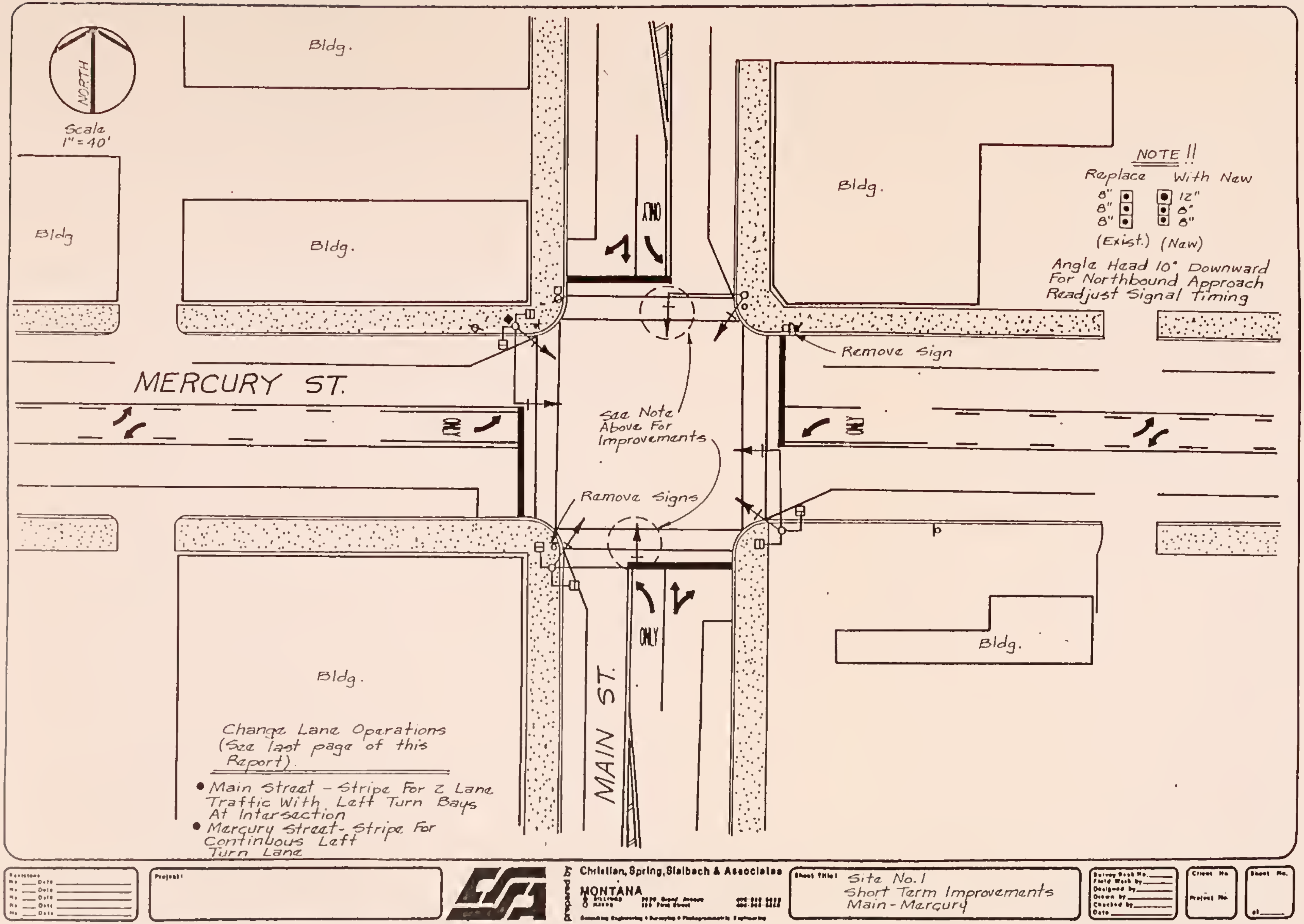
SITE NO. 1 - MAIN - MERCURY



Project

prepared by Christian, Spring, Sielbach & Associates
MONTANA
Consulting Engineering • Surveying • Photogrammetric Engineering

Sheet Title: Site No. 1 Existing Conditions Main - Mercury



NORTH
Scale
1" = 40'
Bldg.
Bldg
Bldg.
Bldg.
NOTE !!
Replace With New
8" 12"
8" 8"
8" 8"
(Exist.) (New)
Angle Head 10° Downward
For Northbound Approach
Readjust Signal Timing
Remove Sign
MERCURY ST.
ONLY
See Note
Above For
Improvements
Remove Signs
MAIN ST.
Bldg.
Bldg.
Change Lane Operations
(See last page of this
Report).
• Main Street – Stripe For 2 Lane Traffic With Left Turn Bays At Intersection
• Mercury Street – Stripe For Continuous Left Turn Lane
Project:
prepared by
Christian, Spring, Sielbach & Associates
MONTANA
Sheet Title: Site No. 1
Short Term Improvements
Main-Mercury
Client No.
Project No.
Sheet No.

S
I
T
E

2

SITE NUMBER 2

HARRISON AVENUE - COBBAN STREET

LOCATION DESCRIPTION

Harrison Avenue is a major north-south arterial which extends through the fringe area business district of Butte. Harrison Avenue connects the southern (mostly residential) portion of Butte with the central business district and residential areas in west and north Butte. Cobban Street is an east-west collector which serves residential areas east and west of Harrison Avenue.

EXISTING CONDITIONS

Geometrics. The intersection of Harrison and Cobban had recently been improved by a Montana Department of Highways Signalization Upgrade Project. The exact date of completion of this project is not known, however it has been in existence for at least the previous year. The Existing Conditions Sketch illustrates the present geometric layout and other features of this intersection.

Signalization. The signal contoller is an Econolite, Solid State, Semi-Actuated Controller with actuation being on Cobban Street. Turning movement counts and signal timing inventories taken at a peak evening hour indicated that with a load factor approaching .3 the maximum green on Harrison was 28 seconds and the maximum green on Cobban was 36 seconds. Both Harrison and Cobban have a 3 second amber with a 1 second lag red. The location of loop detectors and pole boxes could not be determined in the field, therefore loop positioning relative to actuation problems could not be determined.

Signing. There are no existing regulatory signs at this intersection.

Pavement Markings. The existing intersection layout provides for four lanes of traffic on Harrison Avenue with left-turn bays for both north and south bound traffic. Crosswalks are marked for all four approach legs to the intersection.

Traffic Volumes. The following page illustrates a summary of peak hour turning movements at this intersection. The Average Daily Traffic (ADT) expansion of this count produced a north-south entering ADT of 17,320 and an east-west entering ADT of 4,770. A 24-hour machine count in December 1979 on Cobban produced a factored east-west ADT of 4,400. Montana Department of Highways 1978 Harrison Avenue line counts were interpolated at 16,600 ADT.

Traffic Operations. Cobban Avenue at this intersection has an offset alignment across Harrison Avenue, of approximately 36 feet. The offset creates skewed crosswalks and stop bars which inhibit the operation of the intersection in two distinct ways.

1. The pedestrian crossing distance is extended requiring increased green time for pedestrian clearance.

2. Left turning vehicles must extend their path in the intersection prior to negotiating the left turn in order to avoid left-turn Harrison cars stored in the left-turn bay. This maneuver reduces the Cobban to Harrison left-turn capacity, and extends the amount of time for vehicle clearance in the intersection.

Also observed in the field were excessive headways on east bound Cobban Street. The average first car clearance headways across Harrison, is approximately 6 seconds, which is at least 1.5 seconds greater than Harrison Avenue headways. The average headway of following cars was also in excess of 1 second greater than Harrison Avenue headways. It is apparent that this situation is

caused by low grades on storm inlets on the west side of Harrison Avenue. The depressed inlets severely reduce vehicles response time to light changes. In addition, the curb radii on the east bound approach are very abrupt and contribute to inefficient operation.

ACCIDENT ANALYSIS

From the Accident Summary Sheet, it can be seen that the majority of the accidents occurred during the fall or winter months. However, the majority also occurred in clear weather with dry pavement and at night. A significant number of accidents were rear-end type accidents with left-turn accidents being the second most common. Since the number of accidents in the first six months of 1979 are consistent with the past experience in 1977 and 1978, the effect of the signalization project is apparently not reflected by a decrease in the accident rate.

Rear-end collisions occurred almost equally on Harrison northbound and southbound approach legs. Only one rear-end accident occurred on Cobban. The lfet-turn accidents follow a similar pattern with the northbound, southbound approach accidents being equally split.

The occurrence of rear-end type accidents at a signalized intersection is not unusual. However, the 12-inch red lens and three second amber with one second red overlap, would seem to provide an adequate safety factor. Since the intersection is relatively isolated from other signalized intersections and cannot be considered part of an integrated progression system, the cause is narrowed to either overloading of traffic with insufficient green time on Harrison or the condition of sparse traffic with unexpected signal changes. Since the majority of the accidents occurred at evening or at night it is suspected that the latter is the case.

GRAPHIC SUMMARY OF VEHICLE MOVEMENTS

Observer Bob Marvin Date October 3, 1979 Day Wednesday

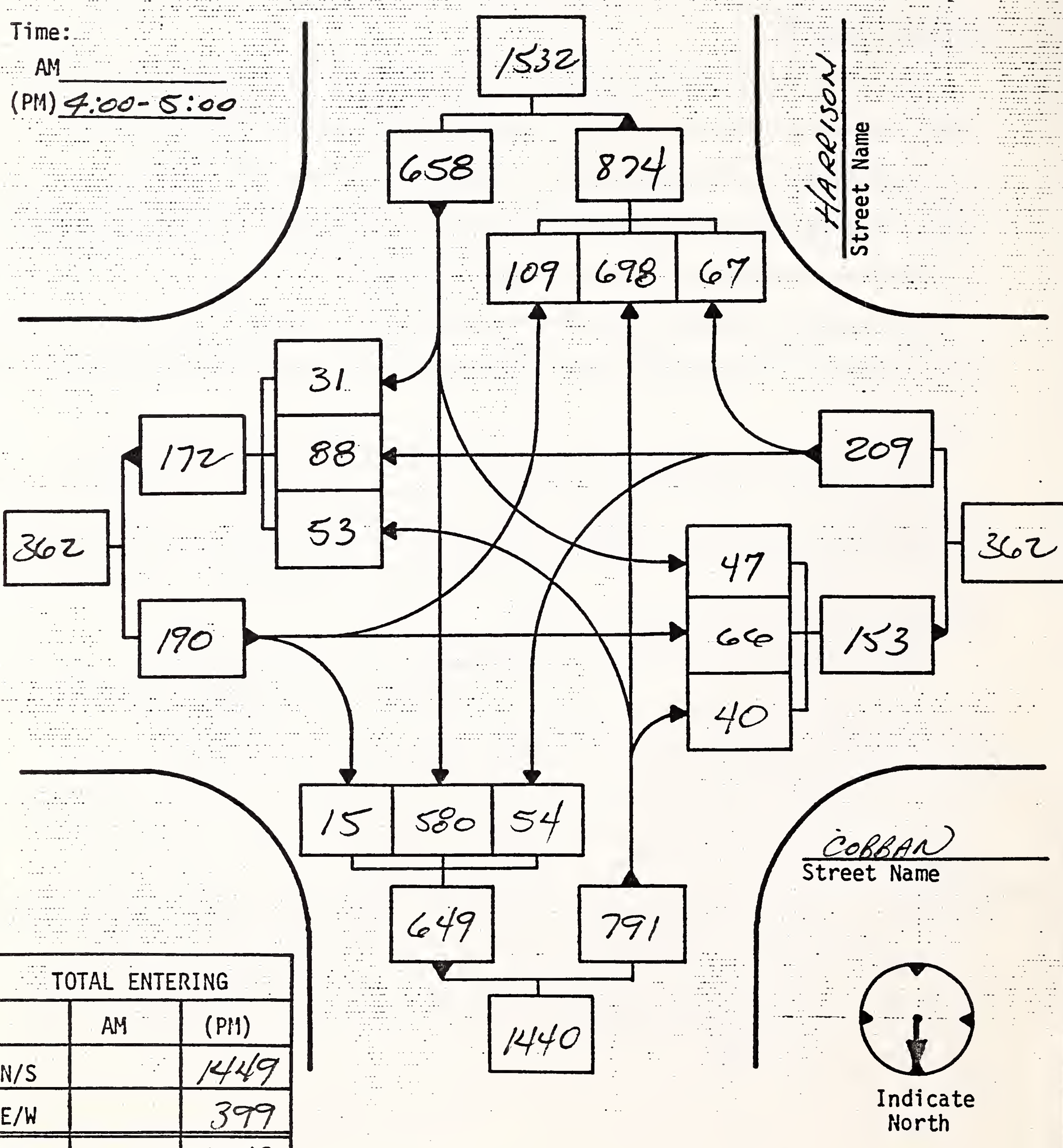
Intersection of Harrison and Cobban

City Butte

Time:

AM

(PM) 4:00-5:00



TOTAL ENTERING		
	AM	(PM)
N/S		1449
E/W		399
Total		1848

CSSA Traffic Form 104

SHORT TERM IMPROVEMENTS

The Short Term Improvement Sketch details some of the recommended changes considered necessary to reduce the accident rate and increase operational efficiency. These improvements involve the following:

1. The stop bar for the north bound and south bound traffic should be relocated to a 90 degree angle from the Harrison Avenue curb and the crosswalks moved to allow a slightly shorter crossing distance. Pedestrian signs prohibiting crossing except at crosswalks should be installed.

2. The southwest corner of the intersection should be reconstructed to provide a 15 foot curb radius which necessitates the signal pole relocation.

3. The inlets at the west approach leg of the intersection should be relocated to the curb radius and a short section of pavement reconstructed to eliminate the adverse dip in that approach.

4. The approach on the west leg of the intersection should be restriped to provide a left-turn lane. Parking on the south side of the street should be eliminated for at least a half a block to facilitate two lanes.

5. The operation of the signals, including minimum and maximum settings on time extensions, should be investigated in greater detail to determine optimum operating conditions of the actuated cycle.

6. Illegal "customer parking only" signs should be removed from in front of the business establishment on the northwest corner of the intersection through whatever enforcement means available to the City of Butte.

LONG TERM IMPROVEMENTS

The Long Term Improvements Sketch illustrates the elimination of the jogged alignment on Cobban Street by providing a smooth transitional curve within the intersection. This improvement would require a minimum amount of right-of-way

without relocating any businesses or residents. The long term improvements also feature exclusive left-turn phases on Harrison Avenue.

ECONOMIC BENEFIT

The anticipated accident reductions and related benefits derived from the recommended improvements are calculated below. The method of computation and forecasting accident reduction is detailed in the "Study Methodology" section of this report.

IMPROVEMENTS	ACCIDENTS		REDUCTION	
	Type	% of Total	% of Type	% of All Accidents
Short Term:	Angle	15	30	5
	Rear-End	42	40	17
	Left-Turn	27	20	5
	Side-Swipe	8	50	4
	Total % Reduction of all Accidents			31
Long Term:	Angle	15	80	12
	Rear-End	42	40	17
	Left-Turn	27	80	21
	Side-Swipe	8	50	4
	Total % Reduction of all Accidents			54

BENEFITS (Dollar Values)

(% Reduction) x (Accidents/Year) x (Useful Project Life) x (Average Severity)

Short Term: (0.31) x (10.4) x (5) x (4,004) = $64,540

Long Term: (0.54) x (10.4) x (20) x (4,004) = $449,730

PRELIMINARY COST ESTIMATE

Short Term Improvements

Item	Quantity	Unit	Unit Price	Cost
Pavement Markings (Plastic Overlay)	1,350	L.F.	$ 1.75	$ 2,360
Regulatory Signs	3	ea.	50.00	150
Relocate Storm Inlets	1	L.S.	2200.00	2,200
Resurface Street	1	L.S.	1500.00	1,500
Construct New Curb	100	L.F.	5.00	500
Relocate Signal Standard	1	L.S.	1500.00	1,500
Miscellaneous Signal Timing	1	L.S.	400.00	400
		Total Short Term Improvement Costs		$ 8,610

Long Term Improvements

Item	Quantity	Unit	Unit Price	Cost
Street Reconstruction (complete curb section, pavement, inlet and storm relocation)	1	L.S.	$55,000.00	$ 55,000
Right-of-Way	1000	S.F.	4.50	4,500
Signal Standards (complete with heads)	2	Ea.	5,000.00	10,000
Relocate Existing Signal Standards	2	Ea.	1,500.00	3,000
New 3-Phase Controller	1	Ea.	20,000.00	20,000
Loop Detectors with Pull Boxes	1	L.S.	8,000.00	8,000
Pavement Markings (plastic Inlay)	3000	L.F.	1.50	4,500
Signs	10	Ea.	110.00	1,100
Contingency (10%)				10,600
		Total Long Term Improvement Costs		$116,700

COST BENEFIT RATIO

The cost benefit ratios for Site Number 2, are calculated below. The Short Term Improvements consider a one time cost on plastic striping while the Long Term Improvements costs incorporate a factor of 4 on the signing and striping over the 20-year life.

Short Term: Cost \$/Benefit \$ = \$8,610/\$64,540 = .1334

Long Term: Cost \$/Benefit \$ = *\$136,500/449,730 = .3035

ACCIDENT SUMMARY

SITE NUMBER 2 LOCATION Harrison - Cobban REPORTING PERIOD November 19, 1979

NUMBERS OF ACCIDENTS

MONTH	NO.
JAN.	
FEB.	4
MARCH	4
APRIL	1
MAY	3
JUNE	1
JULY	1
AUGUST	3
SEPT.	1
OCT.	1
NOV.	4
DEC.	3

DAY OF WK.	NO.
SUN.	1
MON.	3
TUES.	5
WED.	2
THUR.	3
FRI.	6
SAT.	6

WEATHER	NO.
CLEAR	21
RAIN	2
SNOW	3
FOG	
OTHER	

ROAD CONDITION	NO.
DRY	15
WET	4
SNOWY	1
ICY	6
OTHER	

LIGHT CONDITION	NO.
DAY	8
DAWN OR DUSK	2
DARK LIGHTED	16
DARK UN-LIGHTED	

ACCIDENT TYPE	NO.
ANGLE	4
LEFT TURN	7
REAR END	11
HEAD ON	1
SIDE SWIPE	2
PARKED VEHICLE	1
BACKING	
FIXED OBJECT	
PED.	
ANIMAL	

YEAR & SEVERITY	NO.
1977 FATAL	
INJURY	
PROPERTY DAMAGE ONLY	13
1978 FATAL	
INJURY	2
PROPERTY DAMAGE ONLY	6
1979 FATAL	
INJURY	1
PROPERTY DAMAGE ONLY	4

HAZARD INDEX

BASIC COMPUTATIONS

Site Number 2 Date November 19, 1979

Description Harrison - Cobban

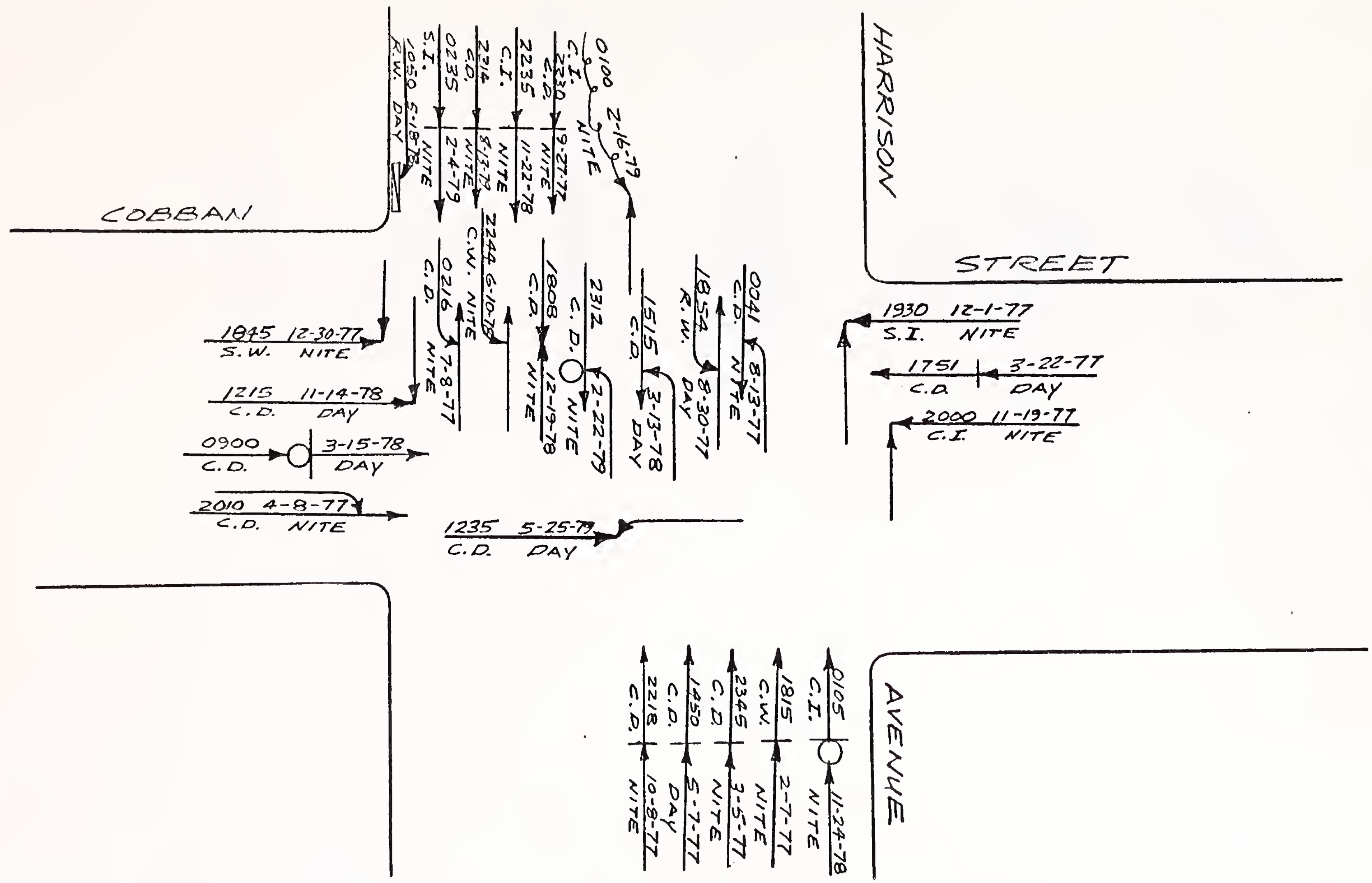
Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	10.4 acc/yr	68	x	0.145	=	9.86
Accident Rate	1.29 acc/MEV	28	x	0.199	=	5.57
Accident Severity	4,004 dollars	44	x	0.169	=	7.44
Volume/Capacity Ratio	.32	49	x	0.073	=	3.58
Sight Distance Ratio	.22 (wt.avg.)	91	x	0.066	=	6.01
Driver Expectancy	3.0 (wt.avg.)	50	x	0.132	=	6.60
Info. System Deficiencies	2.3 (wt.avg.)	38	x	0.102	=	3.88
		SUMS:		0.886*		42.94

$$\text{H.I.} = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{42.94}{0.886} = 48.47$$

* The "Erratic Maneuvers" and "Traffic Conflict" indices were omitted from this study. Therefore the weight factors do not total 1.00 and all sites will be ranked on an 88.6% strength of evaluation relative to the FHWA Method.

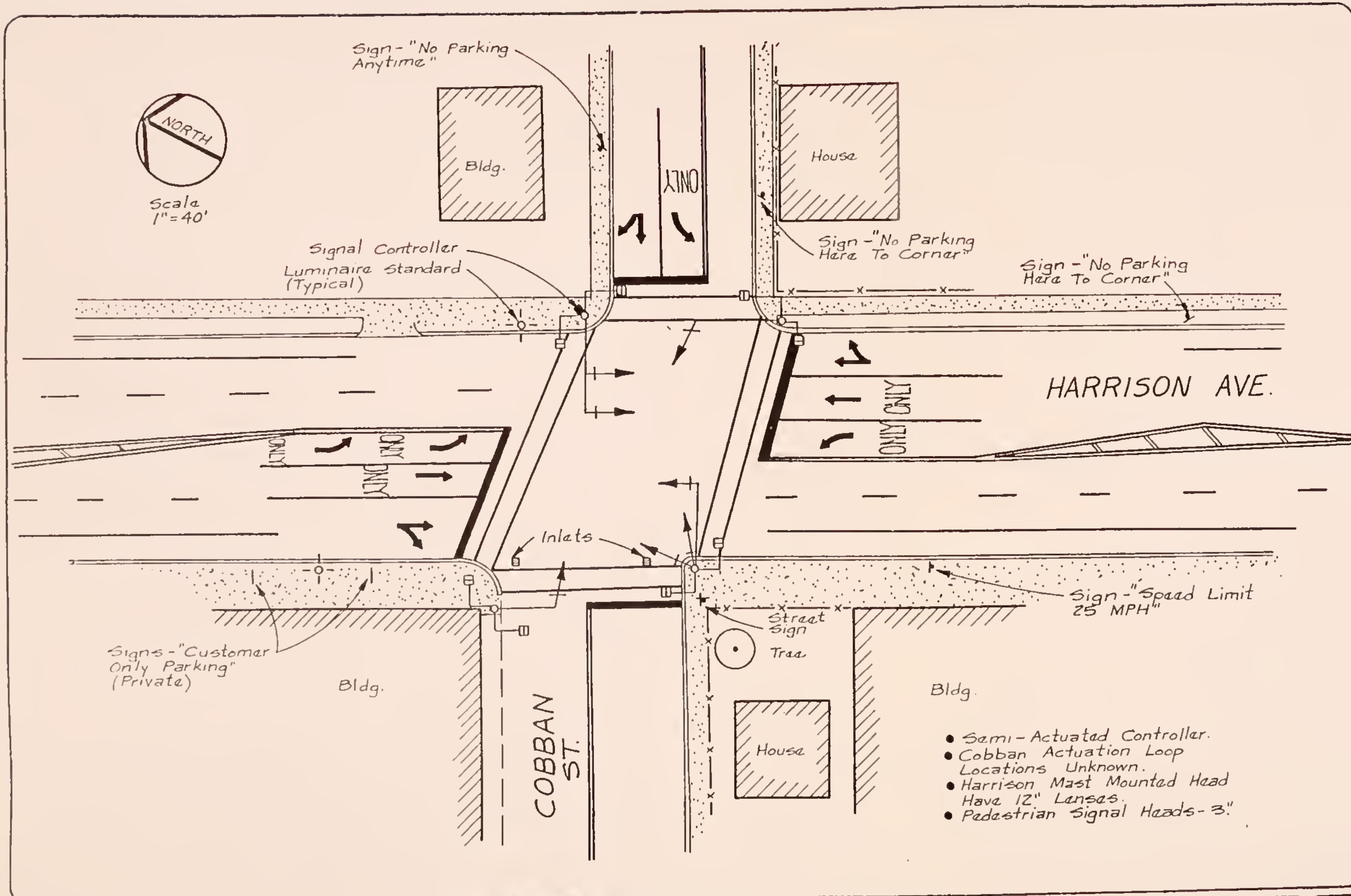
COLLISION DIAGRAM

NORTH



SYMBOLS	COLLISION TYPES	CONDITIONS
VEHICLE PATH	REAR END	WEATHER: C=CLEAR, F=FOG, R=RAIN, S=SNOW, SL=SLEET
PEDESTRIAN PATH	HEAD ON	PAVEMENT: D=DRY, W=WET, I=ICY
BACKING VEHICLE	SIDE SWIPE	TIME 1400 7-05-75 DATE
PARKED VEHICLE	OUT OF CONTROL	WEATHER C.D. DAY LIGHT
FIXED OBJECT	LEFT TURN	PAVEMENT
FATAL ACCIDENT	ANGLE	
INJURY ACCIDENT		

SITE NO. 2 - HARRISON - COBBAN



Revisions

Project:

prepared by Christian, Spring, Sielbach & Associates

MONTANA

Consulting Engineering • Surveying • Photogrammetric Engineering

Sheet Title: Site No. 2
Existing Conditions
Harrison - Cobban

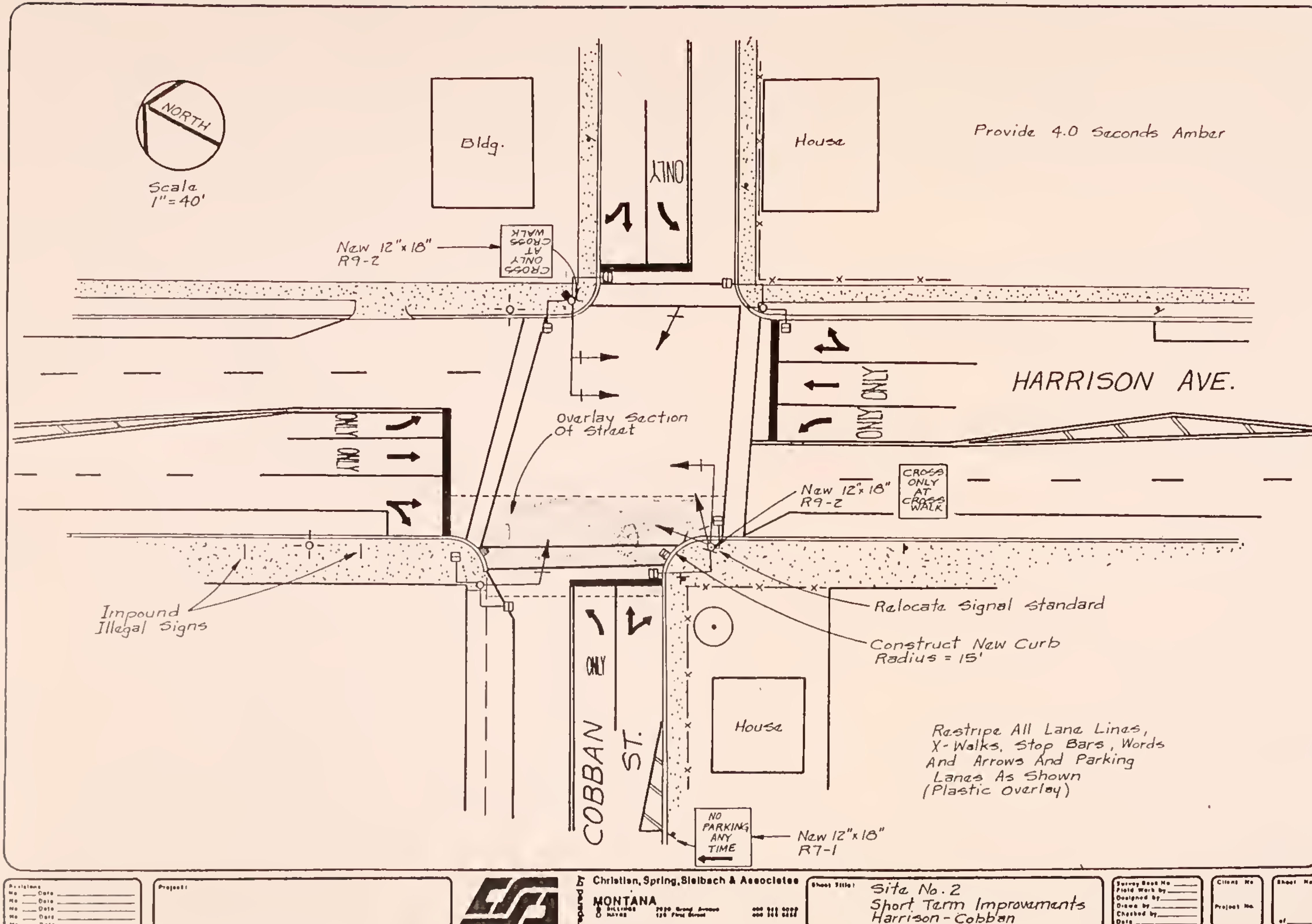
Survey Book No
Field Work by
Designed by
Drawn by
Checked by
Date

Client No

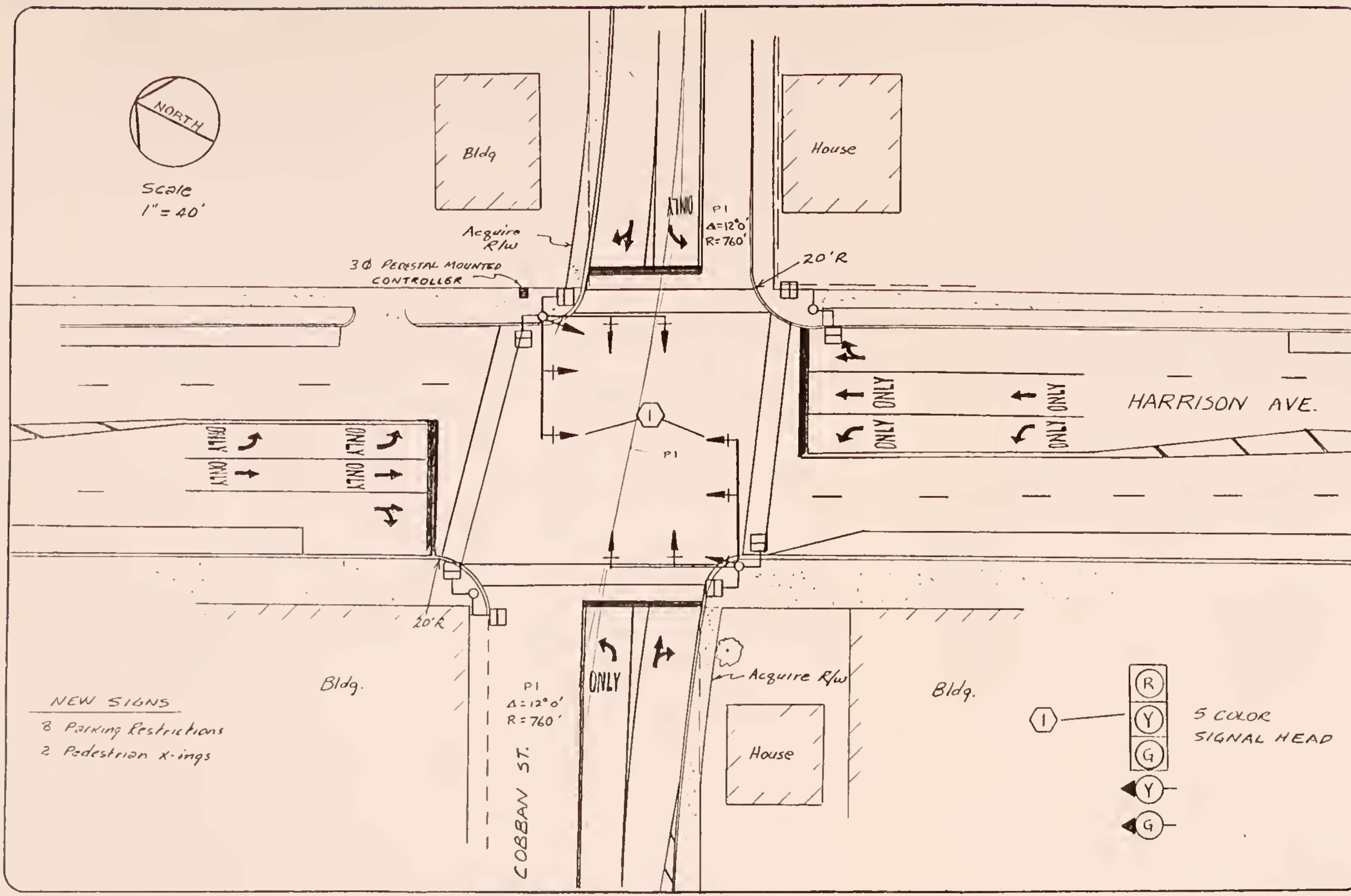
Project No.

Sheet No

of



NORTH
Scale 1" = 40'
Bldg.
House
Provide 4.0 Seconds Amber
ONLY
New 12" x 18" R9-2
CROSS ONLY AT CROSS WALK
HARRISON AVE.
ONLY
ONLY
ONLY
ONLY
Overlay Section Of Street
New 12" x 18" R9-2
CROSS ONLY AT CROSS WALK
Impound Illegal Signs
Relocate Signal Standard
Construct New Curb Radius = 15'
ONLY
House
COBBAN ST.
Restripe All Lane Lines, X-Walks, Stop Bars, Words And Arrows And Parking Lanes As Shown (Plastic Overlay)
NO PARKING ANY TIME
New 12" x 18" R7-1
Revisions
Project:
prepared by
Christian, Spring, Sielbach & Associates
MONTANA
Consulting Engineering • Surveying • Photogrammetric Engineering
Sheet Title:
Site No. 2
Short Term Improvements
Harrison - Cobban
Survey Book No.
Field Work by
Designed by
Drawn by
Checked by
Date
Client No.
Project No.
Sheet No.
of



prepared by Christian, Spring, Sielbsch & Associates
MONTANA

Sheet Title: Site No. 2 Long Term Improvements Harrison - Cobban

SITE 3

SITE NUMBER 3

MONTANA AVENUE - PLATINUM STREET

LOCATION DESCRIPTION

The intersection of Montana Avenue and Platinum Street is located south of the Central Business District (CBD) of uptown Butte. Montana Avenue is a north-south principal arterial which provides access to Interstate 15-90 (coincident) at two locations south of the intersection. Platinum Street is an east-west collector street extending between the west side of Butte and the CBD.

EXISTING CONDITIONS

Geometrics. The Existing Conditions Sketch details the intersection geometrics and surrounding topography. The approach grades on all legs of the intersection are below desireable maximums. Buildings on three of the four corners present severe sight distance restrictions. Parking near the curb radii on all corners is not currently restricted which further reduces sight distance.

Signalization. The intersection is currently controlled by a semi-actuated signal system with actuation on Platinum Street. All signal heads are 3-color 8-inch lens type and all pedestrian heads have 3-inch high letters.

The signal controller is a pedestal mounted solid state "Automatic Signal" brand controller. It is assumed that loop detectors provide the mode of actuation even though pavement saw cuts or patches are not visible.

A separate pedestrian phase with push button actuation for the Montana Avenue crossing is provided. However, it appears that minimum green time on Platinum Street is the same for both vehicle and pedestrian actuation.

All intersection approaches have a 3.0 second amber indication.

Signing. There are no existing signs related to the intersection operations.

Pavement Markings. The existing pavement markings are standard for existing limits of traffic control. Painted strips show significant wear and are only moderately visible.

Traffic Volumes. The figure on the following page is a summary of 4-5 P.M. turning movement counts at this intersection. Average Daily Traffic (ADT) expansion of this count by applying hourly, daily and monthly variations would produce a volume of 11,230 ADT for north-south entering traffic and 4,460 ADT for east-west entering traffic.

An automatic machine count over a 24-hour period in December 1979 produced a calculated ADT of 4,430 for east-west entering traffic. The Montana Department of Highways 1978 count at a station north of this intersection on Montana indicated an ADT of 12,600 which correlates with a 13,060 ADT expansion of the 1979 peak hour count north of Platinum Street. A 4 percent increase in traffic may be indicated.

Traffic Operations. The heavy left turn movement from the north bound leg produces considerable congestion at peak hours. Average approach speeds on Montana Avenue are approximately 30 mph, which may be too fast for the type of existing traffic control devices and intersection geometrics.

GRAPHIC SUMMARY OF VEHICLE MOVEMENTS

Observer K. Behling - K. Brewer Date Nov 15, 1979 Day Thursday

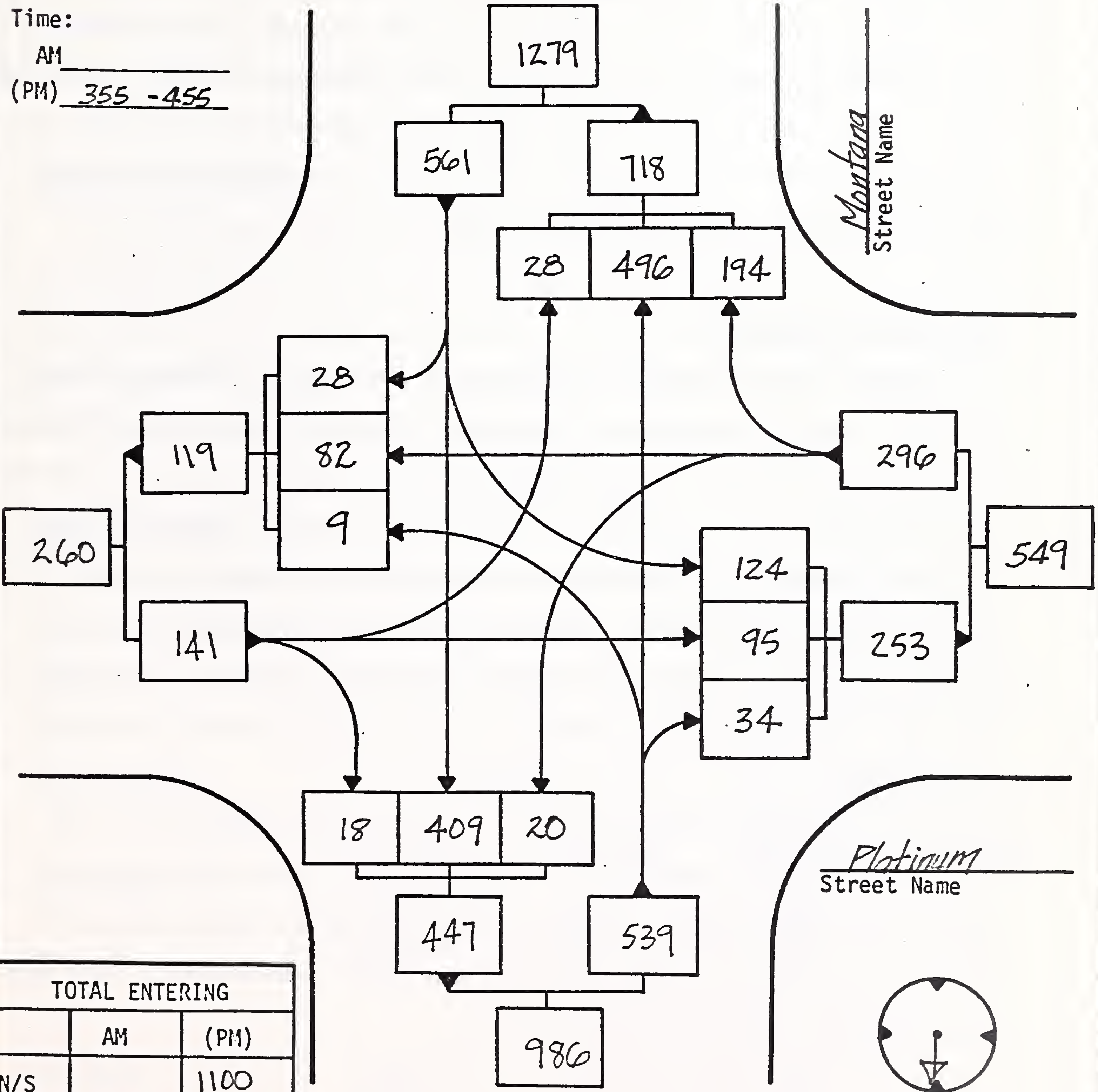
Intersection of Montana and Platinum

City Butte Montana

Time:

AM

(PM) 355 -455



TOTAL ENTERING		
	AM	(PM)
N/S		1100
E/W		437
Total		1537

ACCIDENT ANALYSIS

In the two and one-half year period from 1977 through June 1979, there were 23 reported accidents at the intersection of Montana and Platinum. The Accident Summary Sheet presents significant information pertaining to those accidents.

Most significant, is that almost all accidents occurred during the weekday with the majority occurring in clear weather, dry pavement and during the daylight hours. The accident types indicate a suspiciously high number of left-turn and side-swipe accidents for a signalized intersection which may indicate problems with lane designations and turning movements.

SHORT TERM IMPROVEMENTS

Pavement markings, signing and signal modifications are recommended short term improvements as indicated on the sketch. The major change in operation provided by the improvements is the designation of a left-turn lane for the inside northbound lane. Since 22 percent of peak hour, northbound traffic makes the left-turn movement, a slight decrease in the approach leg capacity is justified for protection of left turning vehicles. The left-turn bay should provide a minimum of 110 feet storage length with 7:1 transition sections on centerline striping. The exact transition section to provide the bay should be detailed during design.

It would be more ideal to eliminate parking on both sides of the street to allow two straight lanes, however the nature of the surrounding buildings require on-street parking. The possibility of providing alternate parking to allow for extra traffic lanes should be investigated as an alternate short term improvement.

Other features of the short term improvements are:

1. Restripe parking lane to provide necessary corner restrictions.

2. Install 12-inch red lenses on Montana Avenue mast mounted signal heads.

3. Set 4.0 second ambers for Montana Avenue to allow additional perception-reaction time.

4. Reset minimum green times to better reflect traffic conditions.

LONG TERM IMPROVEMENTS

The Long Term Improvements Sketch shows the concept of left-turn bays with an exclusive left-turn phase on the signal cycle. Street widening is required to allow 5 - 11 foot traffic lanes and 2 - 8 foot parking lanes. The typical section of the widening street is indicated on the sketch. It is assumed that no additional right-of-way will be required for these improvements.

ECONOMIC BENEFIT

The anticipated accident reductions and related benefits derived from the recommended improvements are calculated below. The method of computation and forecasting accident reduction is detailed in the "Study Methodology" section of this report.

IMPROVEMENTS	ACCIDENTS		REDUCTION	
	Type	% of Total	% of Type	% of All Accidents
Short Term:	Angle	22	50	11
	Left-Turn	30	40	12
	Rear-End	17	50	8
	Side-Swipe	26	40	10
	Total % Reduction of All Accidents			41
Long Term:	Angle	22	60	13
	Left-Turn	30	90	27
	Rear-End	17	50	8
	Side-Swipe	26	90	23
	Total % Reduction of All Accidents			71

BENEFITS (Dollar Values)

(% Reduction) x (Accidents/Year) x (Useful Project Life) x (Average Severity)

Short Term: (0.41) x (9.2) x (5) x (3,829) = $ 72,210

Long Term: (0.71) x (9.2) x (20) x (3,829) = $500,220

PRELIMINARY COST ESTIMATE

Short Term Improvements

Item	Quantity	Unit	Unit Price	Cost
Pavement Markings (Plastic Overlay)	7,000	L.F.	$ 1.75	$12,250
Replace 8" with 12" Signal Lens	2	Ea.	175.00	350
Regulatory Signs	2	Ea.	120.00	240
Miscellaneous Signal Timing	1	L.S.	400.00	400
		Total Short Term Improvements Cost		$13,240

Long Term Improvements

Item	Quantity	Unit	Unit Price	Cost
Street Widening & Reconstruction of Curb Sections (complete)	1	L.S.	$45,000.00	$45,000
Right-of-Way	8000	S.F.	3.50	28,000
New Signal Standards (complete with heads)	2	Ea.	5,000.00	10,000
Relocate Existing Signal Standards	2	Ea.	1,500.00	3,000
New 3-phase Controller with Pedestrian Actuation	1	Ea.	20,000.00	20,000
Loop Detectors & Pull Boxes	1	L.S.	7,000.00	7,000
Pavement Markings (Plastic Overlay)	8000	L.F.	1.75	14,000
Signs	8	Ea.	110.00	880
Contingency 10%				12,800
		Total Long Term Improvements Cost		$140,680

COST BENEFIT RATIO

The cost-benefit ratios are calculated below. The cost of short term improvements does not include annual maintenance and replacement or administrative and engineering costs. The long term cost includes a factor of '4' on signing and striping replacement but do not include administrative or engineering costs.

Short Term: Cost/Benefit = 13,240/72,210 = 0.1834

Long Term: Cost $/Benefit $ = *$185,320/500,220 = 0.3705

*Includes cost of replacement of signing and striping every 5 years.

ACCIDENT SUMMARY

SITE NUMBER 3 LOCATION Montana & Platinum REPORTING PERIOD November 19, 1979

NUMBERS OF ACCIDENTS

MONTH	NO.
JAN.	6
FEB.	1
MARCH	2
APRIL	2
MAY	
JUNE	
JULY	1
AUGUST	1
SEPT.	1
OCT.	6
NOV.	2
DEC.	1

DAY OF WK.	NO.
SUN.	1
MON.	4
TUES.	5
WED.	3
THUR.	6
FRI.	4
SAT.	

WEATHER	NO.
CLEAR	17
RAIN	1
SNOW	5
FOG	
OTHER	

ROAD CONDITION	NO.
DRY	12
WET	3
SNOWY	2
ICY	6
OTHER	

LIGHT CONDITION	NO.
DAY	13
DAWN OR DUSK	3
DARK LIGHTED	7
DARK UN-LIGHTED	

ACCIDENT TYPE	NO.
ANGLE	5
LEFT TURN	7
REAR END	4
HEAD ON	
SIDE SWIPE	6
PARKED VEHICLE	1
BACKING	
FIXED OBJECT	
PED.	
ANIMAL	

YEAR & SEVERITY	NO.
1977 FATAL	
INJURY	
PROPERTY DAMAGE ONLY	8
1978 FATAL	
INJURY	2
PROPERTY DAMAGE ONLY	9
1979 FATAL	
INJURY	
PROPERTY DAMAGE ONLY	4

HAZARD INDEX

BASIC COMPUTATIONS

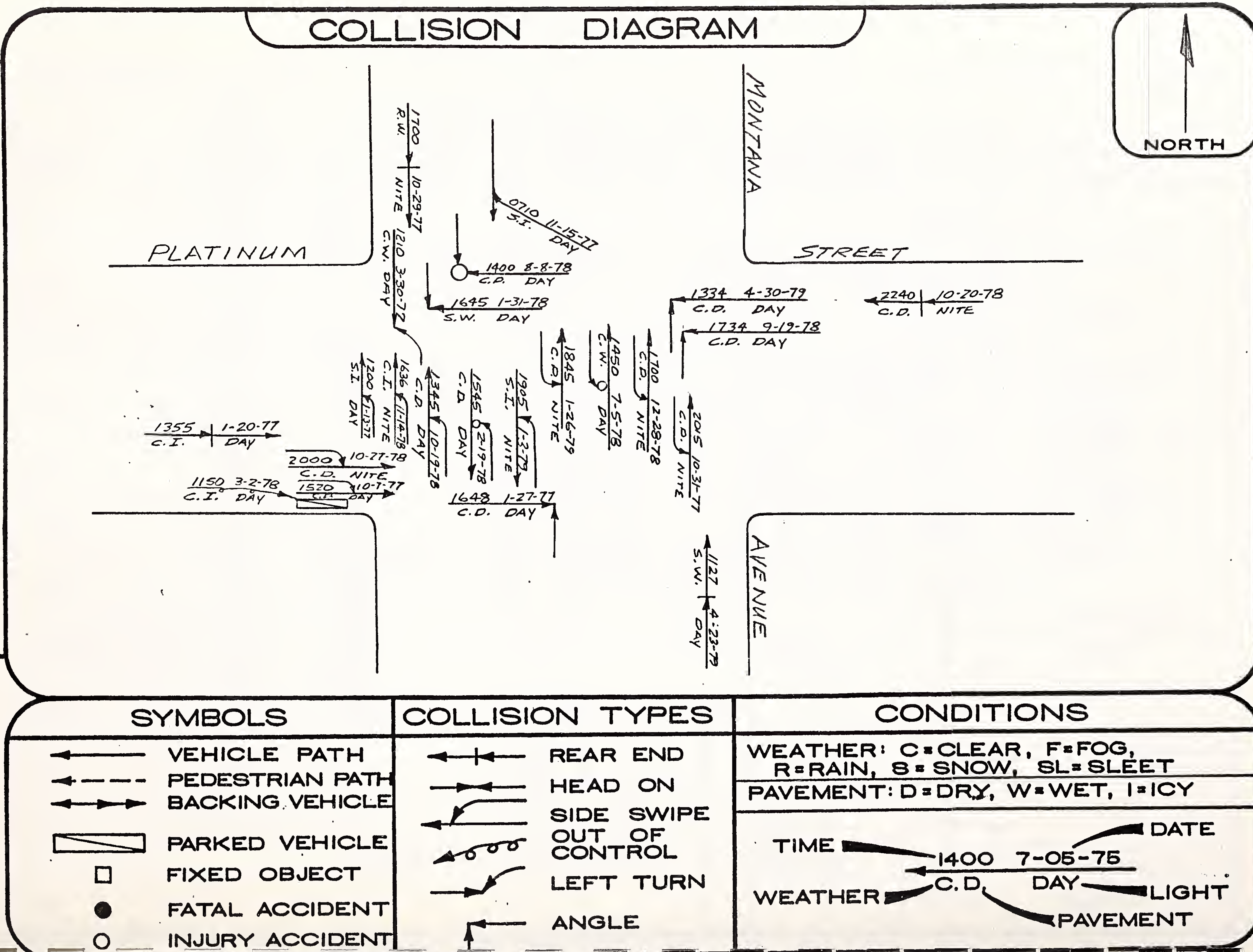
Site Number 3 Date November 19, 1979

Description Montana and Platinum

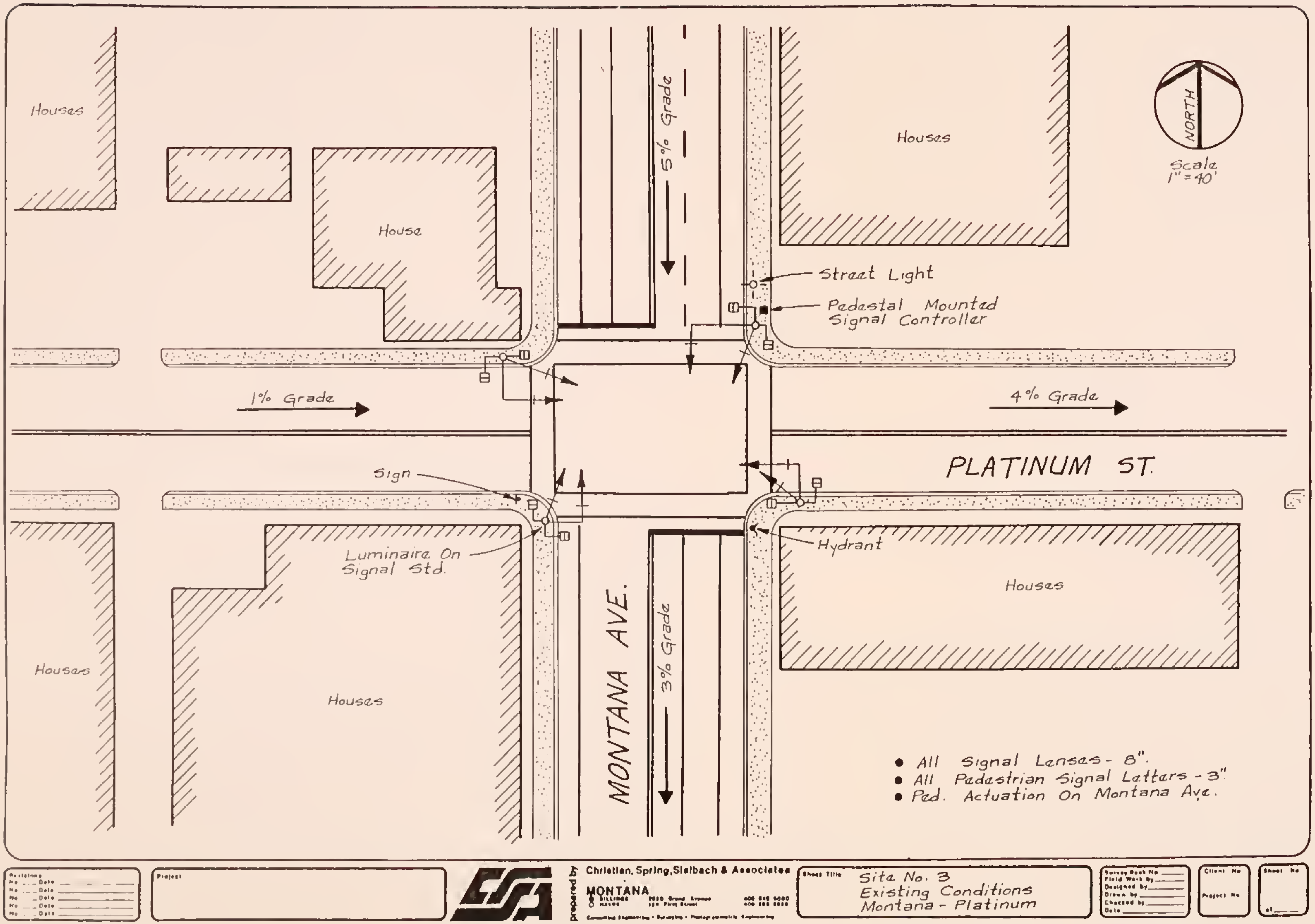
Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	9.2 acc/yr	65	x	0.145	=	9.43
Accident Rate	1.61 acc/MEV	34	x	0.199	=	6.77
Accident Severity	3,829 dollars	43	x	0.169	=	7.27
Volume/Capacity Ratio	0.29	46	x	0.073	=	3.36
Sight Distance Ratio	0.22 (wt.avg.)	91	x	0.066	=	6.01
Driver Expectancy	3.0 (wt.avg.)	50	x	0.132	=	6.60
Info. System Deficiencies	2.7 (wt.avg.)	44	x	0.102	=	4.49
		SUMS:		0.886*		43.93

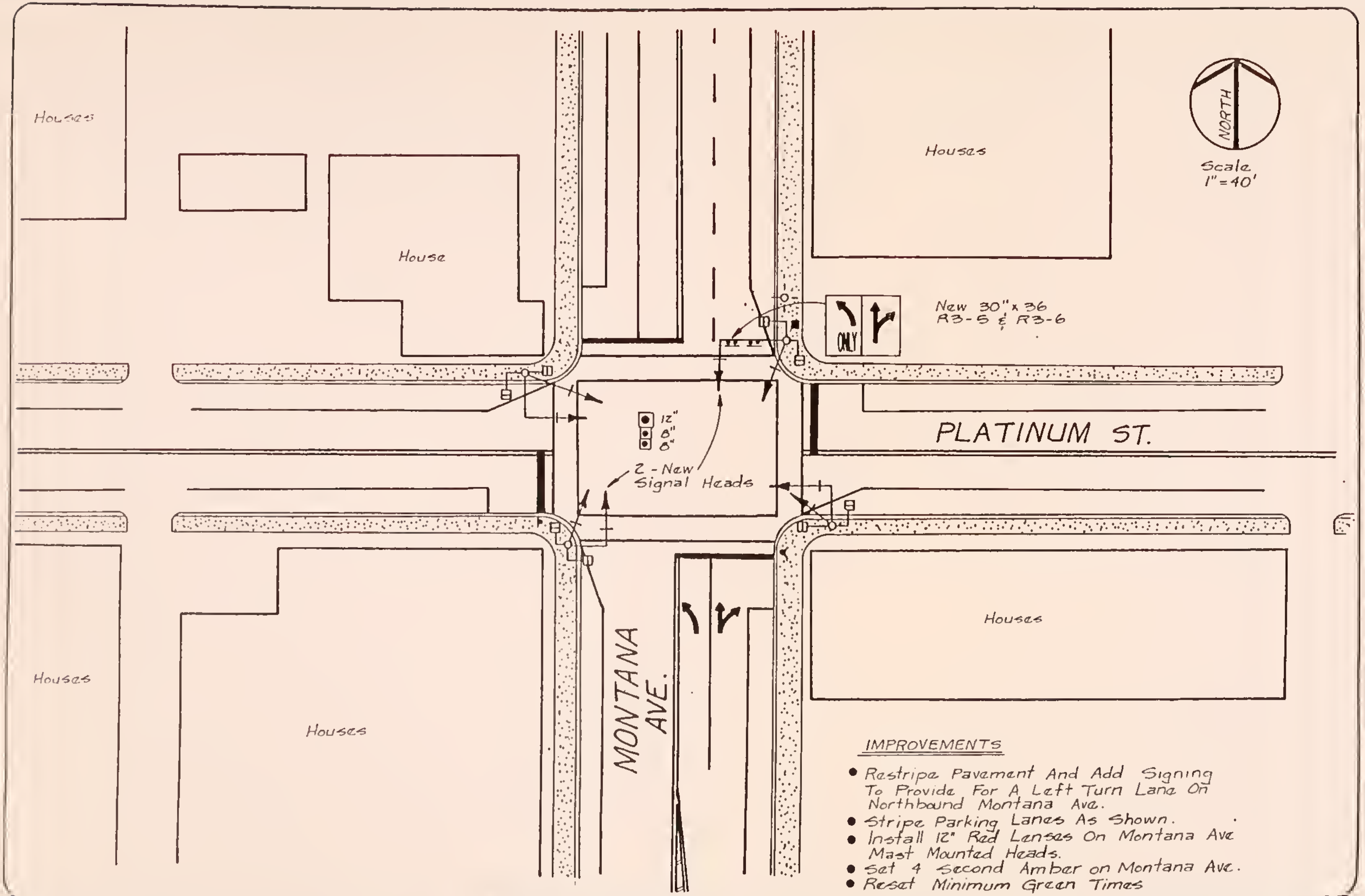
$$\text{H.I.} = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{43.93}{0.886} = 49.58$$

* The "Erratic Maneuvers" and "Traffic Conflict" indices were omitted from this study. Therefore the weight factors do not total 1.00 and all sites will be ranked on an 88.6% strength of evaluation relative to the FHWA Method.



SITE NO. 3 - MONTANA - PLATINUM


Houses
House
Houses
NORTH
Scale 1" = 40'
5% Grade
Street Light
Pedestal Mounted Signal Controller
1% Grade
4% Grade
PLATINUM ST.
Sign
Luminaire On Signal Std.
Hydrant
Houses
Houses
Houses
MONTANA AVE.
3% Grade
• All Signal Lenses - 8".
• All Pedestrian Signal Letters - 3"
• Ped. Actuation On Montana Ave.
prepared by
Christian, Spring, Sielbach & Associates
MONTANA
Consulting Engineering • Surveying • Photogrammetric Engineering
Site No. 3
Existing Conditions
Montana - Platinum



Project:

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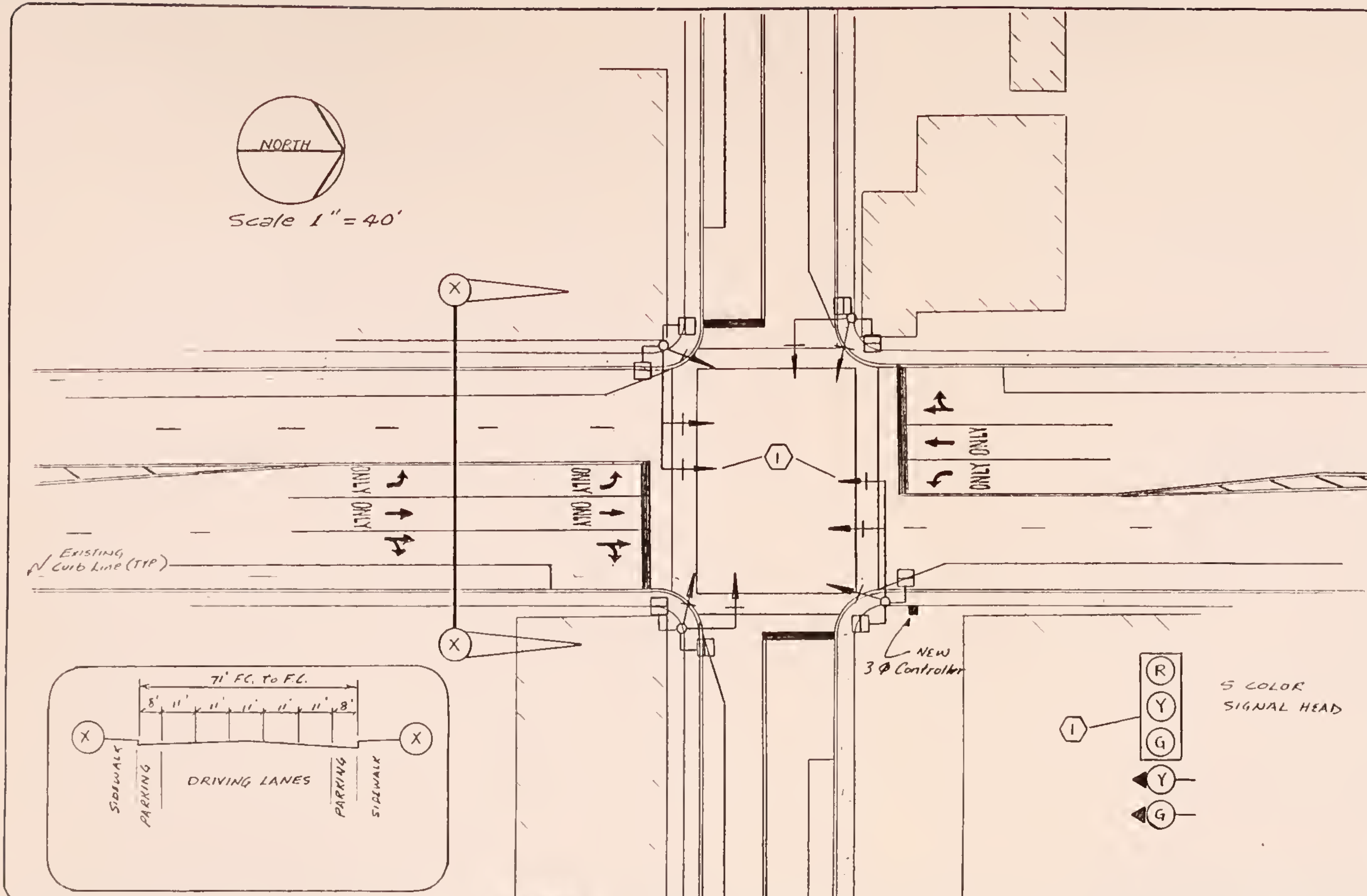
MONTANA

Sheet Title: Site No. 3 Short Term Improvements Montana – Platinum



Revisions No. Date No. Date No. Date No. Date No. Date

Project

prepared by Christian, Spring, Sielbach & Associates

MONTANA
BILLINGS
HAVRE

Consulting Engineering • Surveying • Photogrammetric Engineering

Sheet Title: Site No. 3
Long Term Improvements
Montana - Platinum

Survey Book No. Field Work by Designed by Drawn by Checked by Date

Client No. Project No.

Sheet No. of

SITE 4

SITE NUMBER 4

HARRISON AVENUE - GEORGE STREET

LOCATION DESCRIPTION

The intersection of Harrison Avenue and George Street is located in the fringe business district of Butte. Harrison Avenue is a principle north-south arterial connecting the southern commercial and residential areas of Butte with the central business district in uptown Butte. George Street is a local street with its terminus to the east at Gladstone Avenue. George Street, to the west of the intersection with Harrison, provides a connection with Erwin Street which is an east-west collector street. Its westerly terminus occurring at Montana Avenue

EXISTING CONDITIONS

Geometrics. The Existing Condition Sketch for Site Number 4 outlines all of the existing topography and surrounding features of the intersection. The jogged alignment on the south bound approach and subsequent narrowing of the roadway width to the north combines to present approach sight distance problems. In addition, two-story brick buildings on all four corners of the intersection presents further restrictions to sight distance. Another notable feature of the geometric layout of the intersection is the addition of a skewed side street (Garrison Avenue) intersection George Street on the west approach approximately 50 feet from its intersection with Harrison Avenue.

Signalization. The intersection is signalized and operates in a semi-actuated mode with actuation provided on George Street. The solid state controller is pole mounted on the northeast corner of the intersection. Both Harrison Avenue and George Street traffic are provided a three second amber with no overlapping red. The minimum and maximum green times seem to be sufficient for the traffic volume variations. A separate pedestrian actuation is provided for the Harrison Avenue crossing. The pedestrian signal located in the northwest quadrant in the intersection was found to have two deficiencies. The pedestrian signal indication for west bound crossing is not working and the pedestrian signal head for the northbound crossing is angled in the wrong direction.

No saw cuts or evidence of loop detector installation was noted. It is assumed that actuation is provided by a pavement loop detector arrangement, however the positioning and relative efficiency of operation cannot be determined from existing information.

Signing. There are two non-standard signs existing at this intersection. The signs are "Right On Red After Stop" which has been superceded by the "No Right On Red After Stop" sign as prescribed by current law.

Pavement Markings. The remnants of existing pavement markings indicate that their application was at least standard at some point in time. Although definite crosswalk and stop bar markings were not apparent.

Traffic Volumes. The figure on the following page is a summary of turning movement counts taken during an evening hour counting period. The average daily traffic (ADT) expansion of these counts produces a northbound-southbound

GRAPHIC SUMMARY OF VEHICLE MOVEMENTS

Observer K. Brewer - K. Behling Date Nov. 14, 1979 Day Wednesday

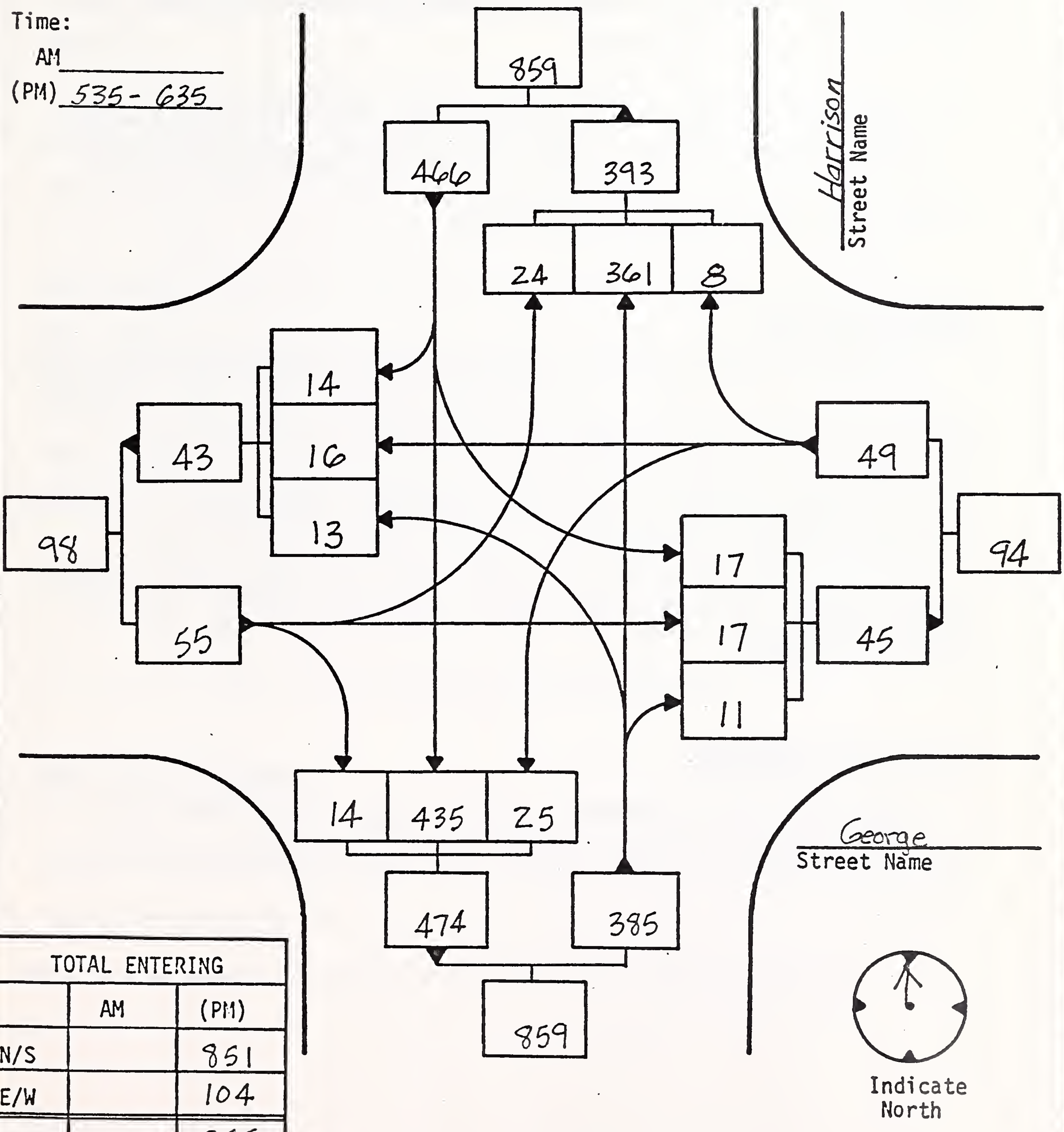
Intersection of Harrison and George

City Butte Montana

Time:

AM

(PM) 535-635



TOTAL ENTERING		
	AM	(PM)
N/S		851
E/W		104
Total		955

CSSA Traffic Form 104

entering volume of approximately 1600 vehicles and an eastbound-westbound entering ADT of 2000. Montana Department of Highways 1978 counts were interpolated to produce a Harrison Avenue line count at approximately 16,900. The correlation between the counts seems accurate enough for accident rate and volume capacity calculations.

Traffic Operations. The operation of this intersection during several field observations was noted as being fairly efficient for the volume of traffic and adverse geometrics in existence.

ACCIDENT ANALYSIS

In the two and one-half year period from 1977 through June of 1979, there were 15 reported accidents. Significant data on the Summary Sheet indicates that the majority of occurrences were on clear days with dry pavement. The accident types seem fairly typical of a signalized intersection. The pedestrian accident, as always, is a matter of concern due to the severity of these type accidents. It is also noted that the majority of accidents occurred in the year 1978.

SHORT TERM IMPROVEMENTS

The basis of the recommended improvements is to improve the channelization and driver expectancy of this intersection. These recommendations are as follows:

1. Restriping of Harrison Avenue and George Street crosswalks with stop

bars aligned at 90° angles to Harrison Avenue curb lines should be completed. This striping will provide a definite path for pedestrian crossings and will provide more adequate definition of left turn movements from George Street.

2. Restriping of parking lanes with proper corner restrictions should be provided.

3. Channelization and lane assignment for the Garrison Avenue approach to George Street should be completed as shown in order to properly control conflicting vehicle movements at that critical point.

4. The signal heads mounted on Harrison Avenue mast arms should be replaced with twelve-inch red lenses and an additional signal head placed on the south bound mast signal arm to provide additional visibility to approaching traffic on the curved alignment of Harrison.

5. The pedestrian signal for the west bound crossing should be repaired.

6. The non-standard "No Right on Red" signs should be removed.

7. Harrison Avenue amber clearance intervals should be extended to 4.0 seconds to allow additional driver reaction time on the signal change.

8. The maximum and minimum settings on the signal cycle should be reset to reflect efficient traffic operation during peak hours.

LONG TERM IMPROVEMENTS

Due to the unknown changes in the operation of Harrison Avenue and the relative future significance of George Street as a major traffic carrier, it is felt that the short term improvements are adequate.

ECONOMIC BENEFIT

The anticipated accident reductions and related benefits derived from the recommended improvements are calculated below. The method of computation and forecasting accident reduction is detailed in the "Study Methodology" section of this report.

IMPROVEMENTS	ACCIDENTS		REDUCTION	
	Type	% of Total	% of Type	% of All Accidents
Short Term:	Angle	27	50	14
	Left-Turn	13	20	3
	Rear-End	20	60	12
	Side-Swipe	27	80	22
	Pedestrian	7	50	3
	Total % Reduction of All Accidents			54

BENEFITS (Dollar Values)

(% Reduction) x (Accidents/Year) x (Useful Project Life) x (Average Severity)

Short Term: (0.54) x (6.0) x (5) x (4,750) = $ 76,950

PRELIMINARY COST ESTIMATE

Short Term Improvements

Item	Quantity	Unit	Unit Price	Cost
Pavement Marking (Plastic Overlay)	3500	L.F.	$ 1.75	$ 6,130
Warning Signs	1	Each	130.00	130
Regulatory Signs	3	Each	120.00	360
Remove Signs	2	Each	30.00	60
Replace 8" Lenses with 12" Lenses	2	Each	175.00	350
New 12-8-8 Signal Head	1	Each	320.00	320
Repair Pedestrian Signal	1	L.S.	150.00	150
Miscellaneous Signal Timing	1	L.S.	400.00	400
				$ 7,900

COST BENEFIT RATIO

The cost-benefit ratio for short term improvements on site #4 is calculated below. The cost does not include administration or engineering and provides for a 5 year useful life of plastic striping and signing.

Short Term: Cost$/ Benefit$ = 7,900/76,950 = 0.1027

ACCIDENT SUMMARY

SITE NUMBER 4 LOCATION Harrison-George REPORTING PERIOD November 20, 1979

NUMBERS OF ACCIDENTS

MONTH	NO.
JAN.	1
FEB.	
MARCH	3
APRIL	1
MAY	1
JUNE	3
JULY	
AUGUST	1
SEPT.	1
OCT.	1
NOV.	2
DEC.	1

DAY OF WK.	NO.
SUN.	3
MON.	
TUES.	1
WED.	3
THUR.	1
FRI.	4
SAT.	3

WEATHER	NO.
CLEAR	12
RAIN	1
SNOW	2
FOG	
OTHER	

ROAD CONDITION	NO.
DRY	10
WET	1
SNOWY	1
ICY	3
OTHER	

LIGHT CONDITION	NO.
DAY	6
DAWN OR DUSK	1
DARK LIGHTED	8
DARK UN-LIGHTED	

ACCIDENT TYPE	NO.
ANGLE	4
LEFT TURN	2
REAR END	3
HEAD ON	
SIDE SWIPE	4
PARKED VEHICLE	
BACKING	
FIXED OBJECT	1
PED.	1
ANIMAL	

YEAR & SEVERITY	NO.
1977 FATAL	
INJURY	2
PROPERTY DAMAGE ONLY	2
1978 FATAL	
INJURY	2
PROPERTY DAMAGE ONLY	8
1979 FATAL	
INJURY	
PROPERTY DAMAGE ONLY	1

HAZARD INDEX

BASIC COMPUTATIONS

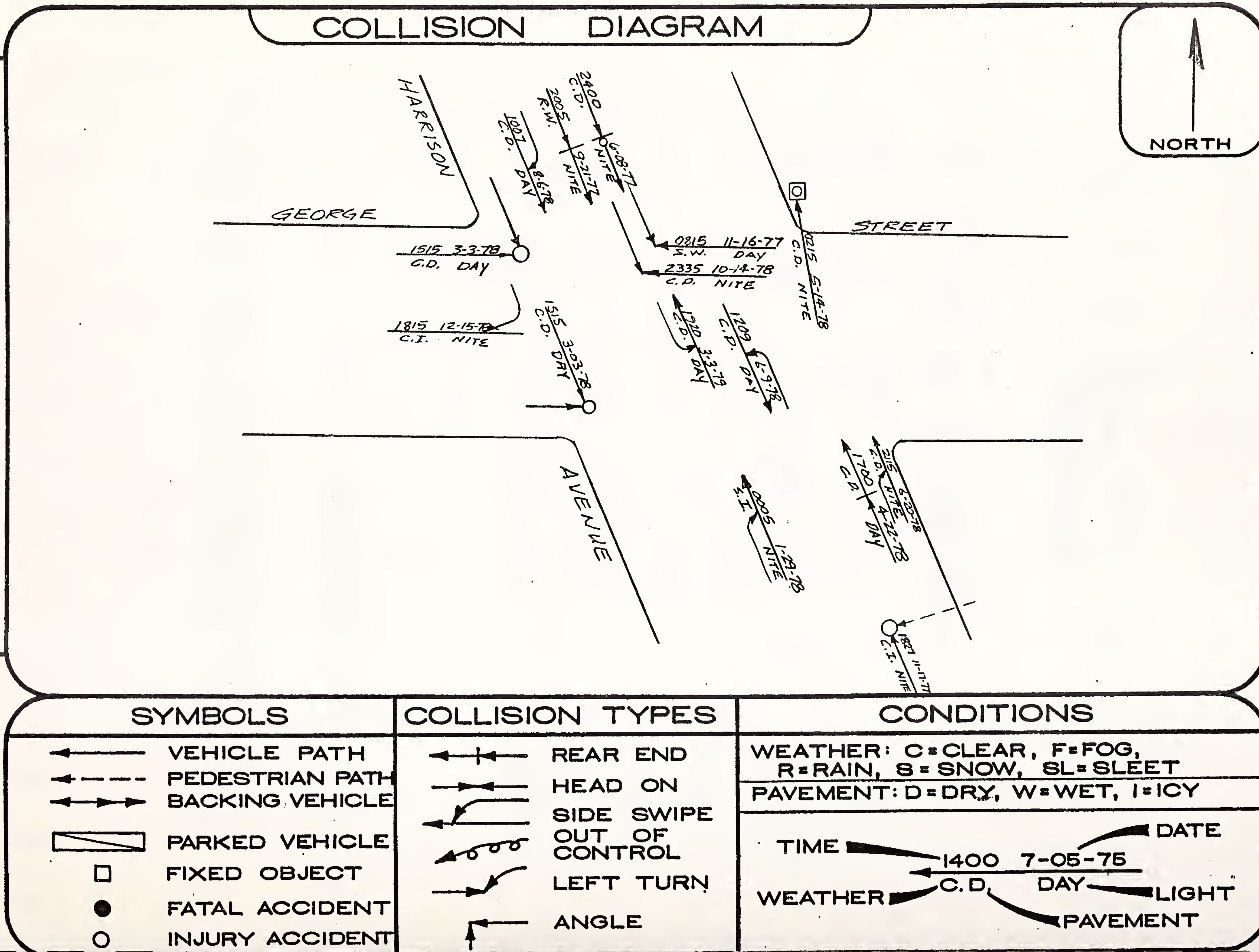
Site Number 4 Date November 20, 1979

Description Harrison - George

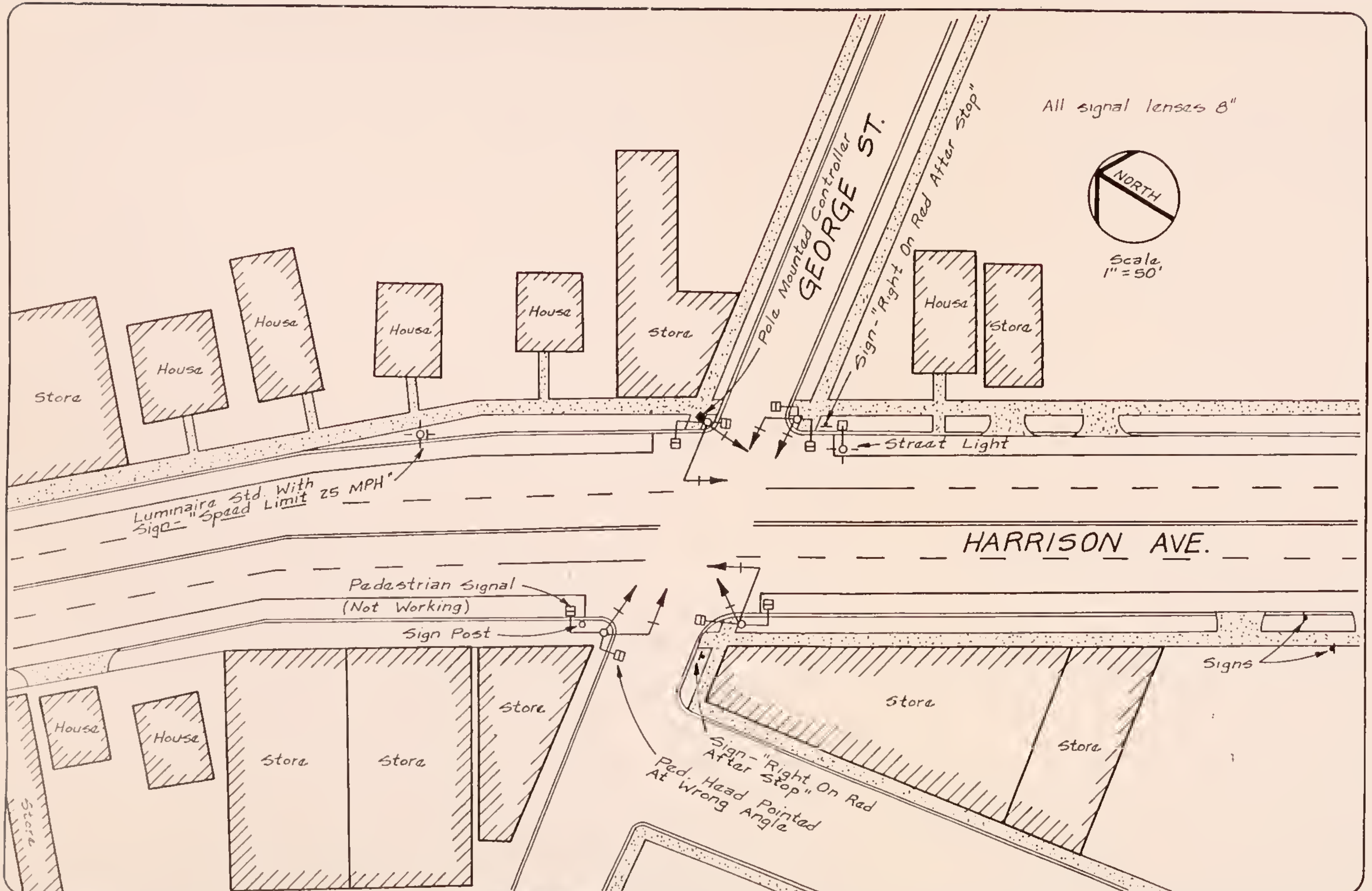
Indicator	Data Value		Indicator Value		Weight		Partial H.I.'s
Number of Accidents	6.0	acc/yr	54	x	0.145	=	7.83
Accident Rate	0.87	acc/MEV	21	x	0.199	=	4.18
Accident Severity	4,750	dollars	47	x	0.169	=	7.94
Volume/Capacity Ratio	0.29		46	x	0.073	=	3.36
Sight Distance Ratio	0.30	(wt.avg.)	87	x	0.066	=	5.74
Driver Expectancy	4.0	(wt.avg.)	67	x	0.132	=	8.84
Info. System Deficiencies	2.0	(wt.avg.)	33	x	0.102	=	3.37
			SUMS:		0.886*		41.26

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{41.26}{0.886} = 46.57$$

* The "Erratic Maneuvers" and "Traffic Conflict" indices were omitted from this study. Therefore the weight factors do not total 1.00 and all sites will be ranked on an 88.6% strength of evaluation relative to the FHWA Method.

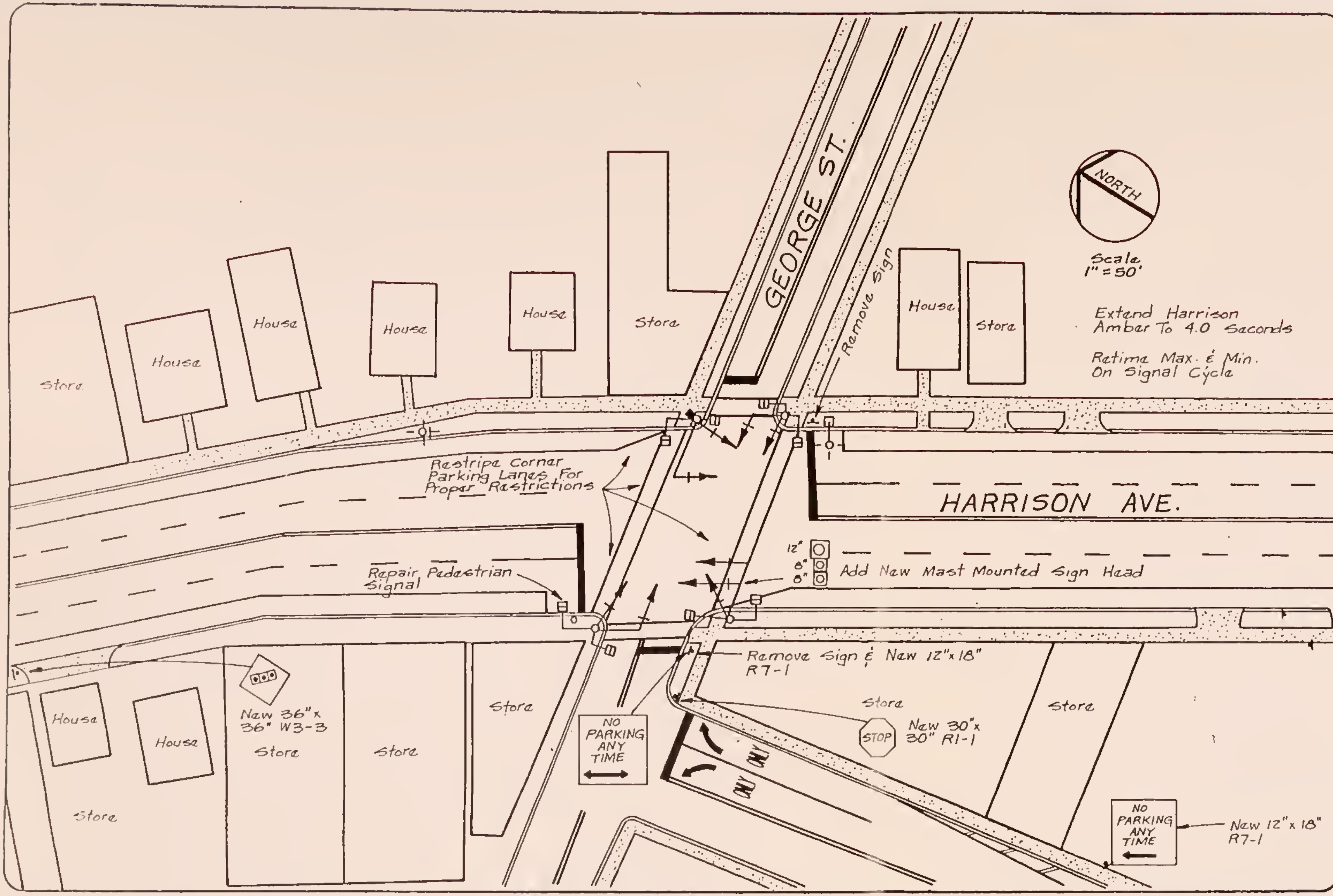


SITE NO. 4 - HARRISON - GEORGE



Prepared by Christian, Spring, Sielbach & Associates
MONTANA
Consulting Engineering • Surveying • Photogrammetric Engineering

Sheet Title: Site No. 4
Existing Conditions
Harrison - George



Christian, Spring, Sielbach & Associates

MONTANA

Sheet Title: Site No. 4
Short Term Improvements
Harrison — George

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5

SITE NUMBER 5

MONTANA AVENUE - MERCURY STREET

LOCATION DESCRIPTION

The intersection of Montana Avenue and Mercury Street is located on the southern fringe of the uptown Butte Central Business District. Montana Avenue is a north-south principal arterial which provides access to Interstate 15-90 (coincident) at two locations south of the intersection. Mercury Street is an east-west collector street with its eastern most terminus at the junction of Federal Aid Primary Route 76 and its western most terminus at Clark Street near the hospital.

EXISTING CONDITIONS

Geometrics. The Existing Condition Sketch details the intersection geometrics and surrounding topography. The approach grades on Montana Avenue are approaching maximum desirable limits of steepness at a 5 percent grade and the approach grades on Mercury Street are slightly milder. The intersection is a right angle, four-legged intersection. Metered parking is provided on all legs of the intersection with several drive approaches located near the intersection. One in particular is the entrance to an auto shop in the southwest quadrant of the intersection. Buildings adjacent to the intersection corners as in other locations of the Butte urban area are fairly close to the right-of-way limits. However, building setbacks do not make the sight distance as critical as in other locations.

Signalization. The intersection of Montana Avenue and Mercury Street is currently signalized and is controlled by a Marbelitie, electro-mechanical,

fixed time controller. The intersection operates on a total cycle length of 50 seconds with Montana Avenue receiving 26 seconds green and Mercury Street receiving 19 seconds. Both Montana and Mercury Street receive a 3.0 second amber clearance interval. All mast mounted signal heads on every approach have 8-inch red lenses and all pedestrian signal heads have 3-inch letter heights.

Signing. There is currently no signing pertinent to the operation of the intersection in existence.

Traffic Volumes. The 4-5 P.M. peak hour turning movement summary sheet is illustrated on the following page. As can be seen there is a heavy left-turn movement from westbound Mercury to southbound Montana and a heavy right-turn movement from eastbound Mercury to southbound Montana. Also the volume of both Montana Avenue left-turn movements are significant. The Average Daily Traffic (ADT) expansion of this peak hour turning movement count resulted in a north-south entering movement on Montana of 8780 vehicles and an east-west entering movement on Mercury of 2870 vehicles. The Montana Department of Highways has a line count station south of the intersection with the 1977 ADT on Montana Avenue being reported as approximately 8700. The 1978 count indicates an ADT of 10,900 at this same location. A 1979 machine count on Mercury Street verified an ADT of approximately 2900 vehicles. The ADT projections correlate well with the 1977 counts and therefore it is assumed that there was a temporary increase in traffic on Montana Avenue during 1978.

Traffic Operations. The operation of the intersection is fairly efficient however, the heavy left-turn movements from Mercury Street approaches and the lack of the positive guidance through lane markings or signing, leads to some conflicts between straight and left turning vehicles. In addition the shop entrance in the southwest quadrant of the intersection sometimes inhibits free street movements on that approach.

GRAPHIC SUMMARY OF VEHICLE MOVEMENTS

Observer R. Marvin Date 11/15/79 Day Thursday

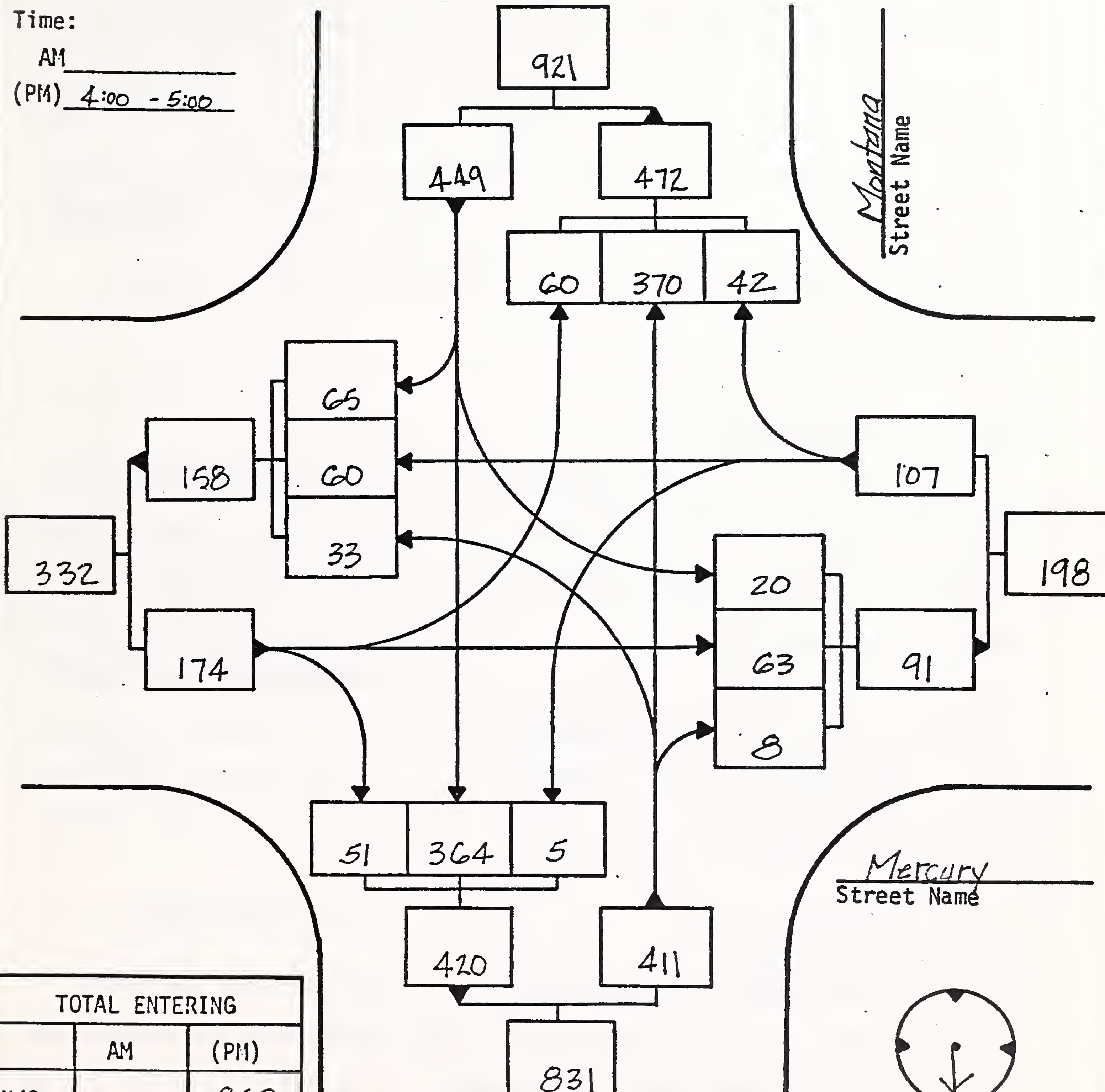
Intersection of Montana and Mercury

City Butte Montana

Time:

AM

(PM) 4:00 - 5:00



TOTAL ENTERING		
	AM	(PM)
N/S		860
E/W		281
Total		1141

ACCIDENT ANALYSIS

In the two and one-half year period from 1977 through June 1979 there were 13 reported accidents at the intersection of Montana Avenue and Mercury Street. The Accident Summary Sheet outlines the significant details of these accidents. It can be seen that the majority of accidents occurred during clear weather conditions on dry roads in the daylight hours. The accidents were either angle accidents or rear-end accidents with three backing accidents.

The number of rear-end accidents is common for a signalized intersection especially when the approach speed in one direction is greater than the other. The angle accidents and backing accidents are not as common to properly signalized intersection.

SHORT TERM IMPROVEMENTS

The Short Term Improvements Sketch details the recommended improvements. The major features of these improvements are the restriping of Mercury Street to provide a left-turn lane on the westbound approach and the replacement of mast mounted signal heads to provide a 12-inch red lense to increase visibility to Montana Avenue approach vehicles. In addition the Montana Avenue amber clearnace interval should be extended to 4.0 seconds. All other improvements deal with parking restrictions at corners and delineation of the parking lanes as shown on the sketch.

LONG TERM IMPROVEMENTS

Due to the adequacy of existing geometrics the moderately low future traffic volumes, it is felt that the short term improvements are adequate and no long term improvements can be recommended at this time.

ECONOMIC BENEFIT

The anticipated accident reductions and related benefits derived from the recommended improvements are calculated below. The method of computation and forecasting accident reduction is detailed in the "Study Methodology" section of this report.

IMPROVEMENTS	ACCIDENTS		REDUCTION	
	Type	% of Total	% of Type	% of All Accidents
Short Term:	Angle	38	50	19
	Left-Turn	8	20	2
	Rear-End	31	50	15
	Backing	23	100	11
	Total % of Reduction of All Accidents			47

BENEFITS (Dollar Values)

(% Reduction) x (Accidents/Year) x (Useful Project Life) x (Average Severity)

Short Term: (0.57) x (5.2) x (5) x (3806) = $46,508

PRELIMINARY COST ESTIMATE

Short Term Improvements

Item	Quantity	Unit	Unit Price	Cost
Pavement Marking (Plastic Overlay)	3600	L.F.	$ 1.75	$ 6,300
Replace 8" with 12" Signal Lenses	2	ea.	175.00	350
Miscellaneous Signal Timing	1	L.S.	400.00	400
Total Short Term Improvements Cost				$ 7,050

COST BENEFIT RATIO

The cost benefit ratio is computed below. Costs are based on a 5-year life with no annual maintenance, replacement, administrative or engineering costs considered:

$$\text{Cost \$/Benefit \$} = 7050/46{,}508 = \underline{0.1516}$$

ACCIDENT SUMMARY

SITE NUMBER 5 LOCATION Montana-Mercury REPORTING PERIOD November 20, 1979

NUMBERS OF ACCIDENTS

MONTH	NO.
JAN.	
FEB.	3
MARCH	
APRIL	2
MAY	2
JUNE	1
JULY	1
AUGUST	1
SEPT.	
OCT.	2
NOV.	1
DEC.	

DAY OF WK.	NO.
SUN.	1
MON.	1
TUES.	3
WED.	4
THUR.	2
FRI.	
SAT.	2

WEATHER	NO.
CLEAR	11
RAIN	
SNOW	2
FOG	
OTHER	

ROAD CONDITION	NO.
DRY	9
WET	2
SNOWY	2
ICY	
OTHER	

LIGHT CONDITION	NO.
DAY	8
DAWN OR DUSK	2
DARK LIGHTED	3
DARK UN-LIGHTED	

ACCIDENT TYPE	NO.
ANGLE	5
LEFT TURN	1
REAR END	4
HEAD ON	
SIDE SWIPE	
PARKED VEHICLE	
BACKING	3
FIXED OBJECT	
PED.	
ANIMAL	

YEAR & SEVERITY	NO.
1977 / FATAL	
INJURY	1
PROPERTY DAMAGE ONLY	7
1978 / FATAL	
INJURY	
PROPERTY DAMAGE ONLY	3
1979 / FATAL	
INJURY	
PROPERTY DAMAGE ONLY	2

HAZARD INDEX

BASIC COMPUTATIONS

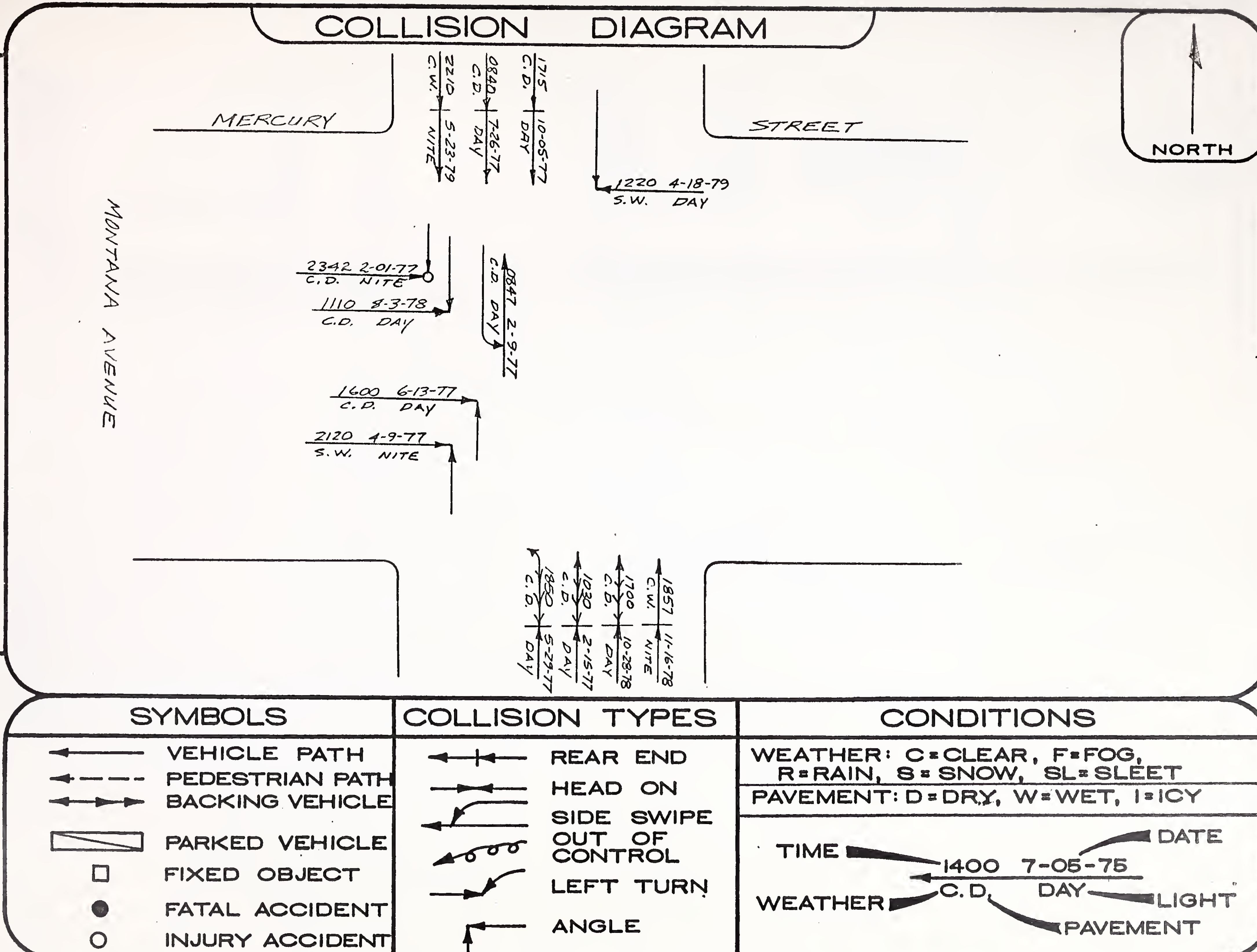
Site Number 5 Date November 20, 1979

Description Montana-Mercury

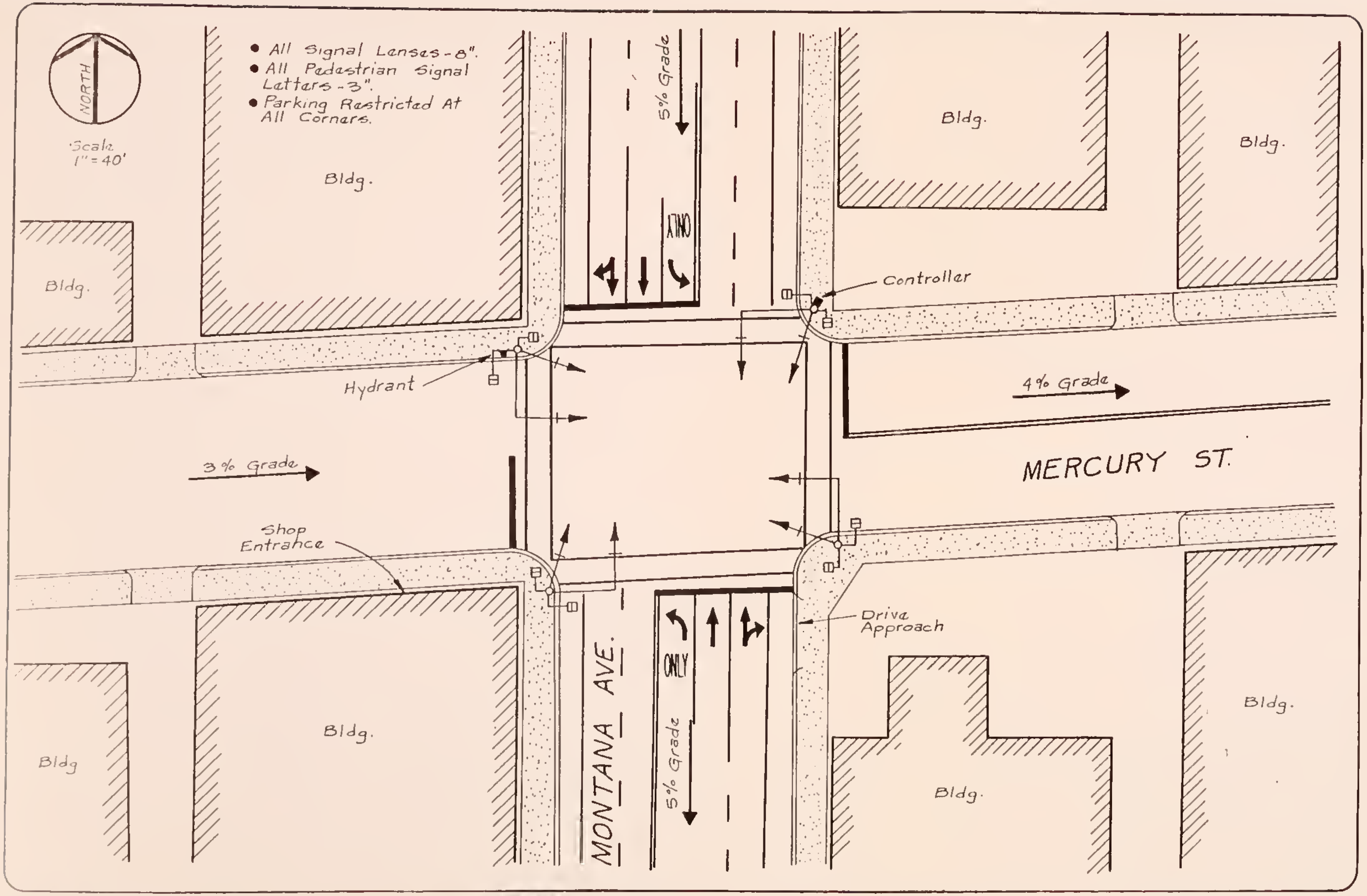
Indicator	Data Value		Indicator Value		Weight		Partial H.I.'s
Number of Accidents	5.2	acc/yr	52	x	0.145	=	7.54
Accident Rate	1.09	acc/MEV	26	x	0.199	=	5.17
Accident Severity	3,806	dollars	43	x	0.169	=	7.27
Volume/Capacity Ratio	.18		36	x	0.073	=	2.63
Sight Distance Ratio	.31	(wt.avg.)	87	x	0.066	=	5.74
Driver Expectancy	3.0	(wt.avg.)	50	x	0.132	=	6.60
Info. System Deficiencies	2.5	(wt.avg.)	42	x	0.102	=	4.28
			SUMS:		0.886*		39.23

$$\text{H.I.} = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{39.23}{0.886} = 44.28$$

* The "Erratic Maneuvers" and "Traffic Conflict" indices were omitted from this study. Therefore the weight factors do not total 1.00 and all sites will be ranked on an 88.6% strength of evaluation relative to the FHWA Method.

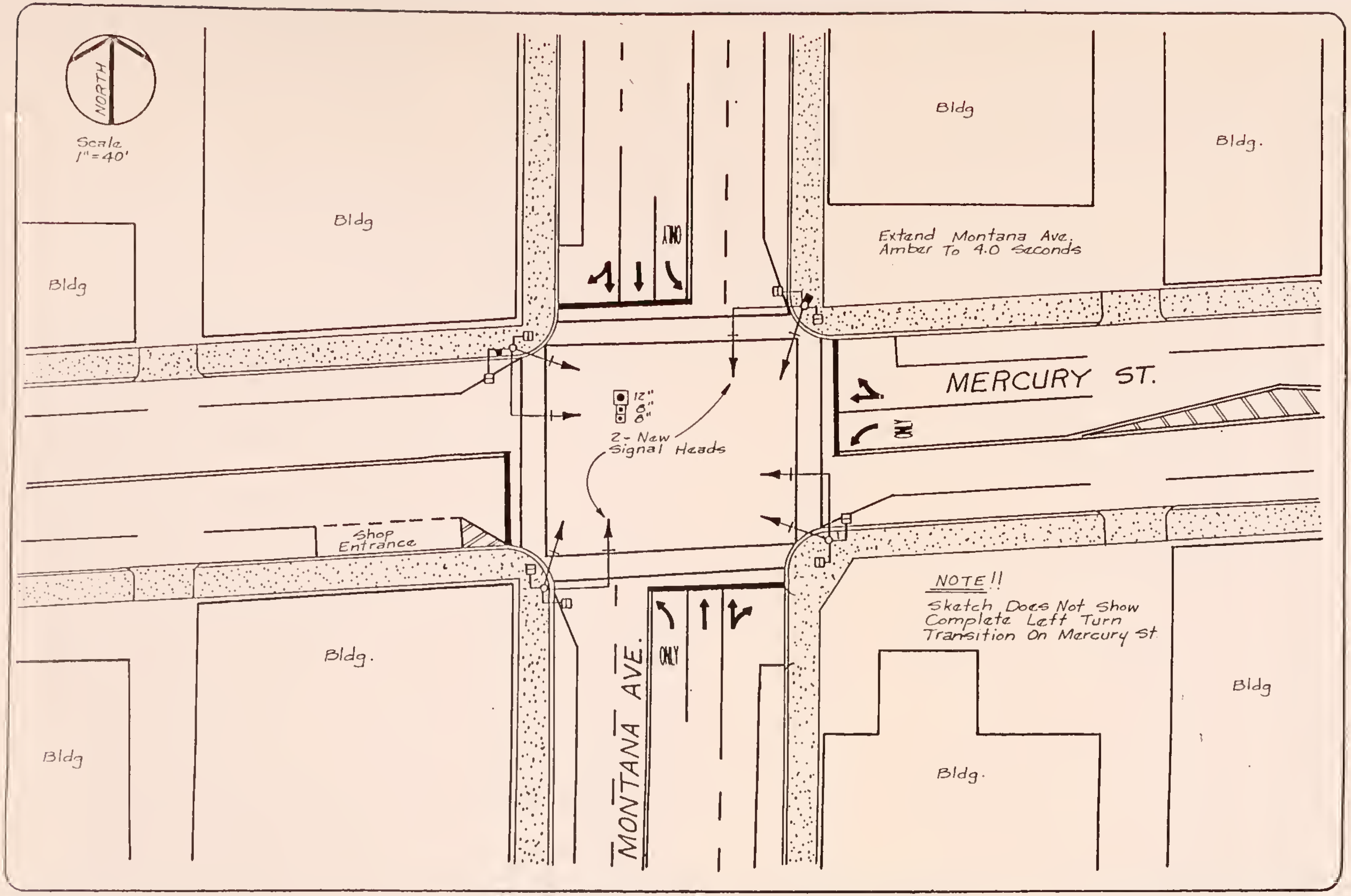


SITE NO. 5 - MONTANA - MERCURY



prepared by Christian, Spring, Sielbach & Associates
MONTANA

Sheet Title: Site No. 5
Existing Conditions
Montana - Mercury



Prepared by Christian, Spring, Sielbach & Associates
MONTANA

Sheet Title: Site No. 5
Short Term Improvements
Montana - Mercury

Field Book No. ____
Field Work by ____
Designed by ____
Drawn by ____
Checked by ____
Date ____

Client No.
Project No.
Sheet No.
of ____

SITE 6

SITE NUMBER 6

MAIN STREET - FRONT STREET

LOCATION DESCRIPTION

The intersection of Main Street and Front Street is located south of the Central Business District of Butte and is the junction between two principal arterial streets. Main Street is a north-south arterial extending from and through the Central Business District, south to Front Street. At Front Street, its name changes to Kaw Avenue which continues south. Front Street is an east-west arterial which originates to the west of the intersection as Harrison Avenue and continues through the intersection with Main Street to the west with an eventual connection to Interstate 15-90 (coincident).

EXISTING CONDITIONS

Geometrics. The Existing Condition Sketch details the existing topography of the Main and Front Street intersection. The approach grades are relatively mild. The intersection is a four-legged, right angle intersection. The alignment of the approaches on both Main Street southbound and Front Street eastbound have significant curvature. The south leg of the intersection has a three track railroad mainline crossing approximately 250 to 270 feet south of the intersection. Approach sight distance at this intersection is relatively clear except for the building located in the southeast quadrant of the intersection, which restricts sight distance for northbound and westbound traffic.

Signalization. The intersection is presently signalized and is controlled by a pole mounted Econolite, solid state, semi-actuated controller. Since pavement saw cuts or patches are not visible it is assumed that loop detectors

provide the mode of actuation. All signal heads are three-color with 8-inch lenses and all pedestrian signal heads have 3-inch high letters.

The maximum green times are 15 seconds on Front Street and 23 seconds on Main Street, all approach legs have a 3.0 second amber clearance time. Total cycle length is approximately 46 seconds.

Signing. The existing signing is standard but does not adequately reflect conditions prevailing at the intersection.

Pavement Markings. The existing pavement markings are standard up to the point in which they were applied, however, crosswalks, stop bars, and all pavement markings on Main Street are nonexistent.

Traffic Volumes. The figure on the following page is a summary of morning and evening peak turning movement counts at the intersection of Main and Front. The Average Daily Traffic (ADT) expansion of this count by applying hourly, daily, and monthly variations produces a volume of 8600 for the north-south entering traffic and an ADT of 7400 for the east-west entering traffic. The 24-hour machine counts taken in December, substantiates this ADT expansion. No counts during 1977 or 1978 are available from the Montana Department of Highways.

Traffic Operations. The intersection operates efficiently with the exception of vehicle positioning on approach legs due to the lack of proper lane assignments. This condition exists primarily on Main Street approaches where striping is not currently existent.

ACCIDENT ANALYSIS

In the two and one-half year period from 1977 through June 1979 there were 14 reported accidents. From the Accident Summary Sheet, it can be seen that

GRAPHIC SUMMARY OF VEHICLE MOVEMENTS

Observer Ken Behling Date 11/27-11/28 Day Tuesday & Wednesday

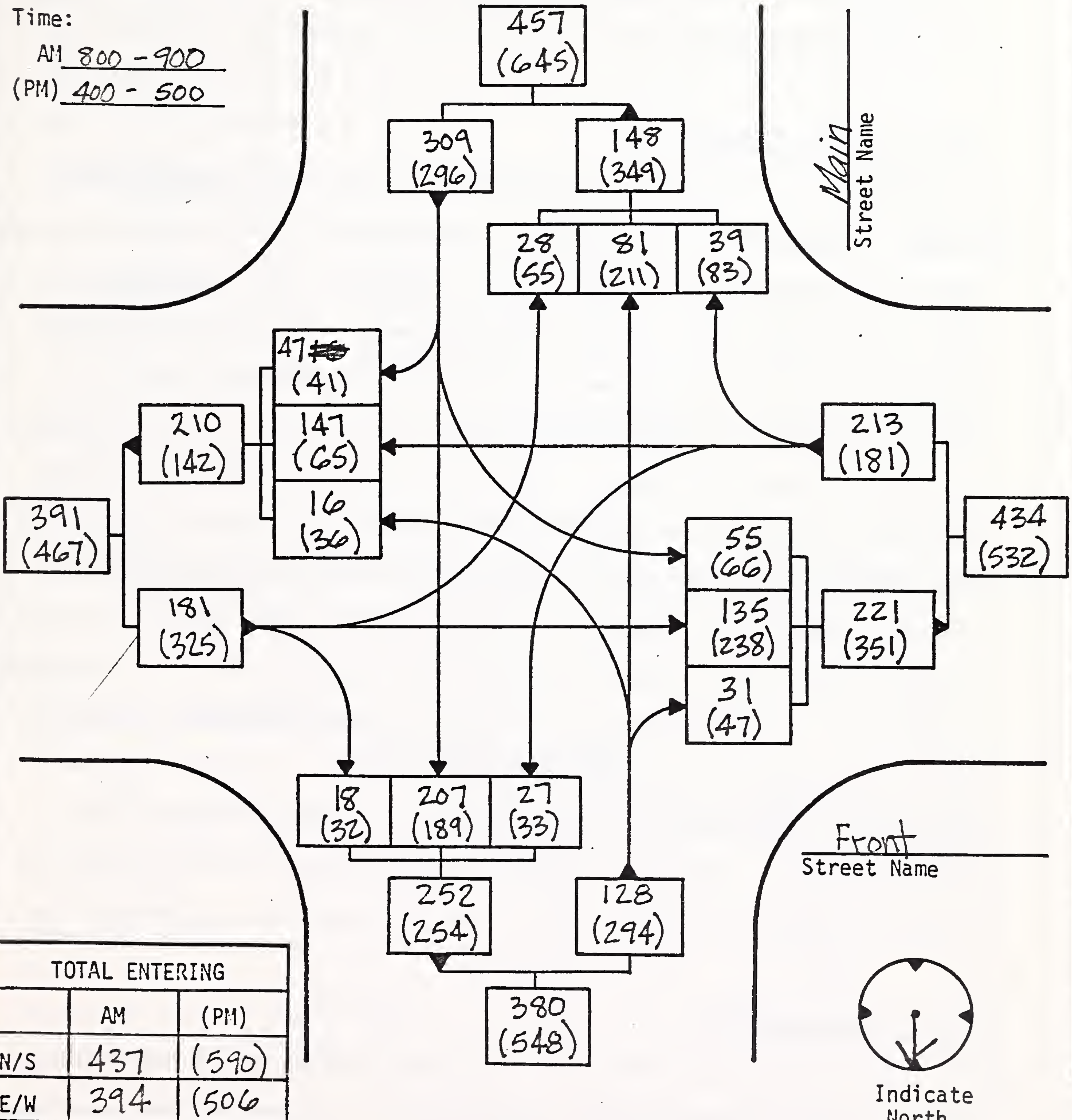
Intersection of Main and Front

City Butte Mt.

Time:

AM 800 - 900

(PM) 400 - 500



TOTAL ENTERING		
	AM	(PM)
N/S	437	(590)
E/W	394	(506
Total	831	(1096)

the majority of accidents occurred in clear weather on dry streets during daylight conditions. The majority of accidents were angle accidents with left-turn accidents being second in frequency, followed by two rear-end accidents. The predominance of angle accidents as opposed to rear-end accidents is unusual at a signalized intersection.

SHORT TERM IMPROVEMENTS

Restriping of pavement markings to delineate lane designations on Main Street and improvements to upgrade striping standards at the intersection along with improved signing are all part of the recommended short term improvements as indicated on the Short Term Improvements Sketch. The left-turn movements from Main Street to Front Street for both north and southbound traffic are significant enough to designate exclusive left-turn lanes. Therefore pavement striping indicating lane usage in addition to regulatory signs on the signal mast arms indicating lane assignment is advised. A restriction of parking at all corners to alleviate current problems with restricted sight distance due to parked vehicles is recommended. Advanced signal warning signs on the west, north and south legs of the intersection is felt necessary due to the alignment conditions. In addition to the striping and signing improvements, it is recommended that the 8-inch red mast mounted lens on all approach legs be modified by installing new 12-inch red lenses to increase visibility for approach traffic. The amber clearance intervals should also be increased 4.0 seconds to increase the safety margin of driver expectancy and reaction time.

LONG TERM IMPROVEMENTS

Due to the lack of positive planning data, in regard to future system use and warrants it is not practical at this time to recommend any long term improve-

ments at this intersection.

ECONOMIC BENEFIT

The anticipated accident reductions and related benefits derived from the recommended improvements are calculated below. The method of computation and forecasting accident reduction is detailed in the "Study Methodology" section of this report.

IMPROVEMENTS	ACCIDENT		REDUCTION	
	Type	% of Total	% of Type	% of All Accidents
Short Term:	Angle	36	70	25
	Left-Turn	29	60	17
	Rear-End	14	10	1
	Side-Swipes	7	50	3
	Total % Reduction of All Accidents			46

BENEFITS (Dollar Values)

(% Reduction) x (Accidents/Year) x (Useful Project Life) x (Average Severity)

Short Term: (0.46) x (5.2) x (5) x (4,071) = $48,689

PRELIMINARY COST ESTIMATE

Short Term Improvements

Item	Quantity	Unit	Unit Price	Cost
Pavement Markings	5,500	L.F.	$ 1.75	$ 9,630
Warning Signs	3	Ea.	150.00	450
Regulatory Signs	4	Ea.	110.00	440
Pindown Curb	50	L.F.	9.00	450
Replace 8" with 12" Signal Lens	4	Ea.	175.00	700
Miscellaneous Signal Timing	1	L.S.	400.00	400
Total Short Term Improvements Cost				$12,070

COST BENEFIT RATIO

The cost benefit calculation is shown below. The cost of administration and engineering is not included nor is the cost of annual maintenance and replacement of signing or pavement markings.

Cost \$/Benefit \$ = 12,070/48,689 = 0.2479

ACCIDENT SUMMARY

SITE NUMBER 6 LOCATION Front and Main REPORTING PERIOD November 20, 1979

NUMBERS OF ACCIDENTS

MONTH	NO.
JAN.	
FEB.	3
MARCH	2
APRIL	
MAY	
JUNE	1
JULY	1
AUGUST	2
SEPT.	1
OCT.	
NOV.	
DEC.	3

DAY OF WK.	NO.
SUN.	
MON.	4
TUES.	3
WED.	1
THUR.	1
FRI.	3
SAT.	1

WEATHER	NO.
CLEAR	11
RAIN	
SNOW	2
FOG	
OTHER	

ROAD CONDITION	NO.
DRY	6
WET	3
SNOWY	1
ICY	3
OTHER	

LIGHT CONDITION	NO.
DAY	8
DAWN OR DUSK	1
DARK LIGHTED	4
DARK UN-LIGHTED	

ACCIDENT TYPE	NO.
ANGLE	5
LEFT TURN	4
REAR END	2
HEAD ON	1
SIDE SWIPE	1
PARKED VEHICLE	
BACKING	
FIXED OBJECT	
PED.	
ANIMAL	

YEAR & SEVERITY	NO.
1977 / FATAL	
INJURY	
PROPERTY DAMAGE ONLY	5
1978 / FATAL	
INJURY	
PROPERTY DAMAGE ONLY	4
1979 / FATAL	
INJURY	2
PROPERTY DAMAGE ONLY	2

HAZARD INDEX

BASIC COMPUTATIONS

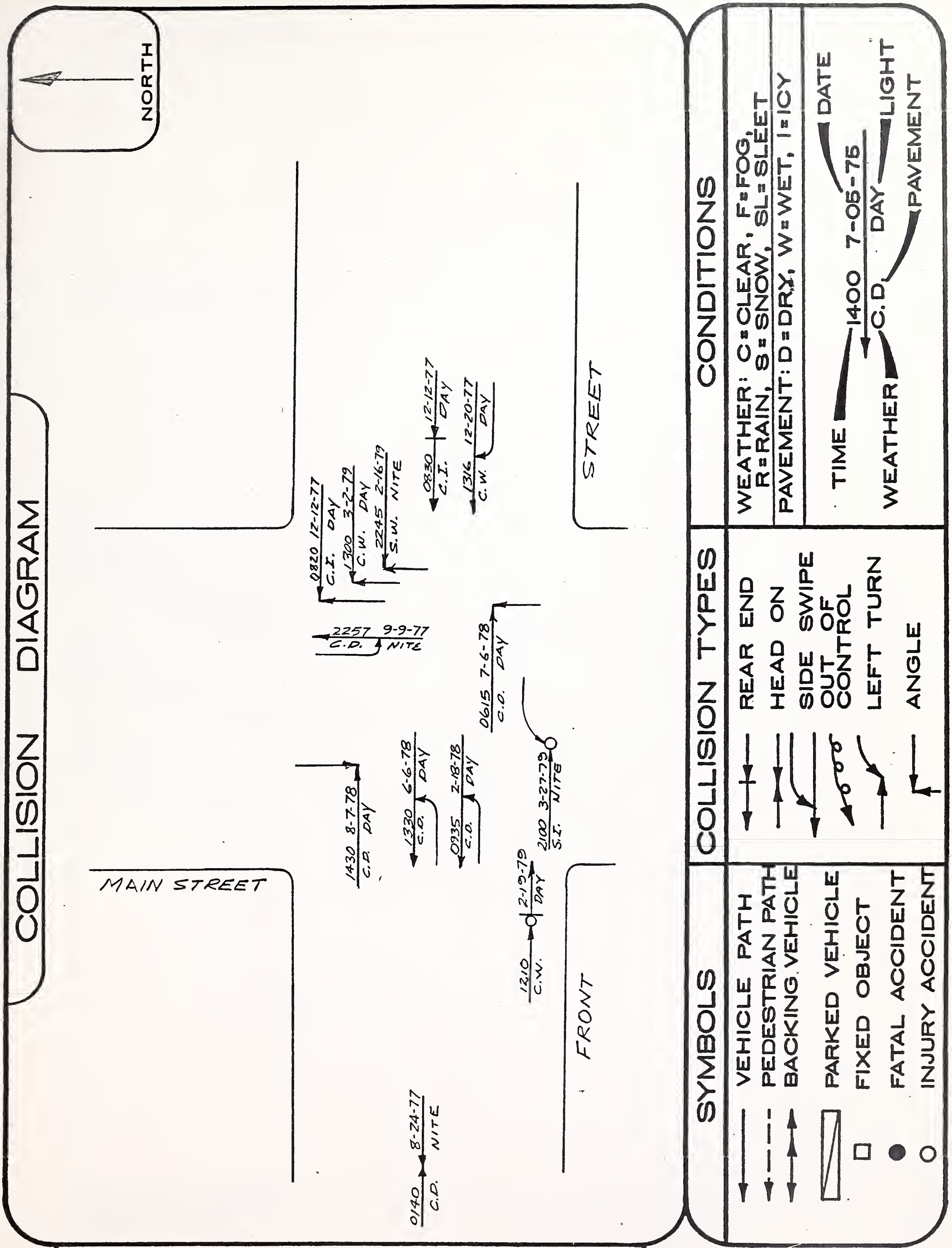
Site Number 6 Date November 20, 1979

Description Front and Main

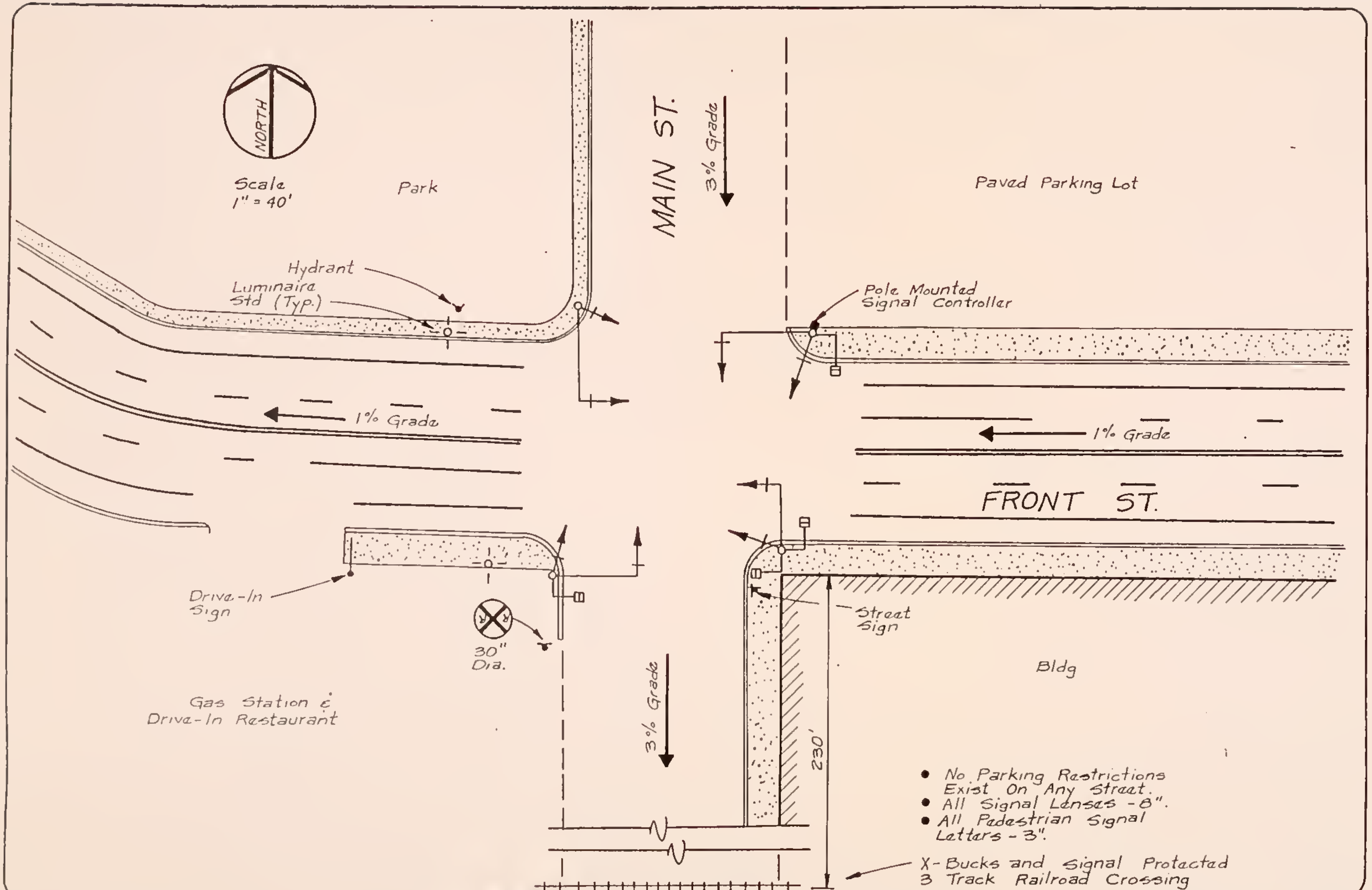
Indicator	Data Value		Indicator Value		Weight		Partial H.I.'s
Number of Accidents	5.2	acc/yr	52	x	0.145	=	7.54
Accident Rate	0.89	acc/MEV	21	x	0.199	=	4.18
Accident Severity	4,071	dollars	44	x	0.169	=	7.44
Volume/Capacity Ratio	0.26		43	x	0.073	=	3.14
Sight Distance Ratio	0.33	(wt.avg.)	85	x	0.066	=	5.61
Driver Expectancy	3.8	(wt.avg.)	63	x	0.132	=	8.32
Info. System Deficiencies	4.0	(wt.avg.)	67	x	0.102	=	6.83
			SUMS:		0.886*		43.06

$$\text{H.I.} = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{43.06}{0.886} = 48.60$$

* The "Erratic Maneuvers" and "Traffic Conflict" indices were omitted from this study. Therefore the weight factors do not total 1.00 and all sites will be ranked on an 88.6% strength of evaluation relative to the FHWA Method.



SITE NO. 6 - FRONT - MAIN



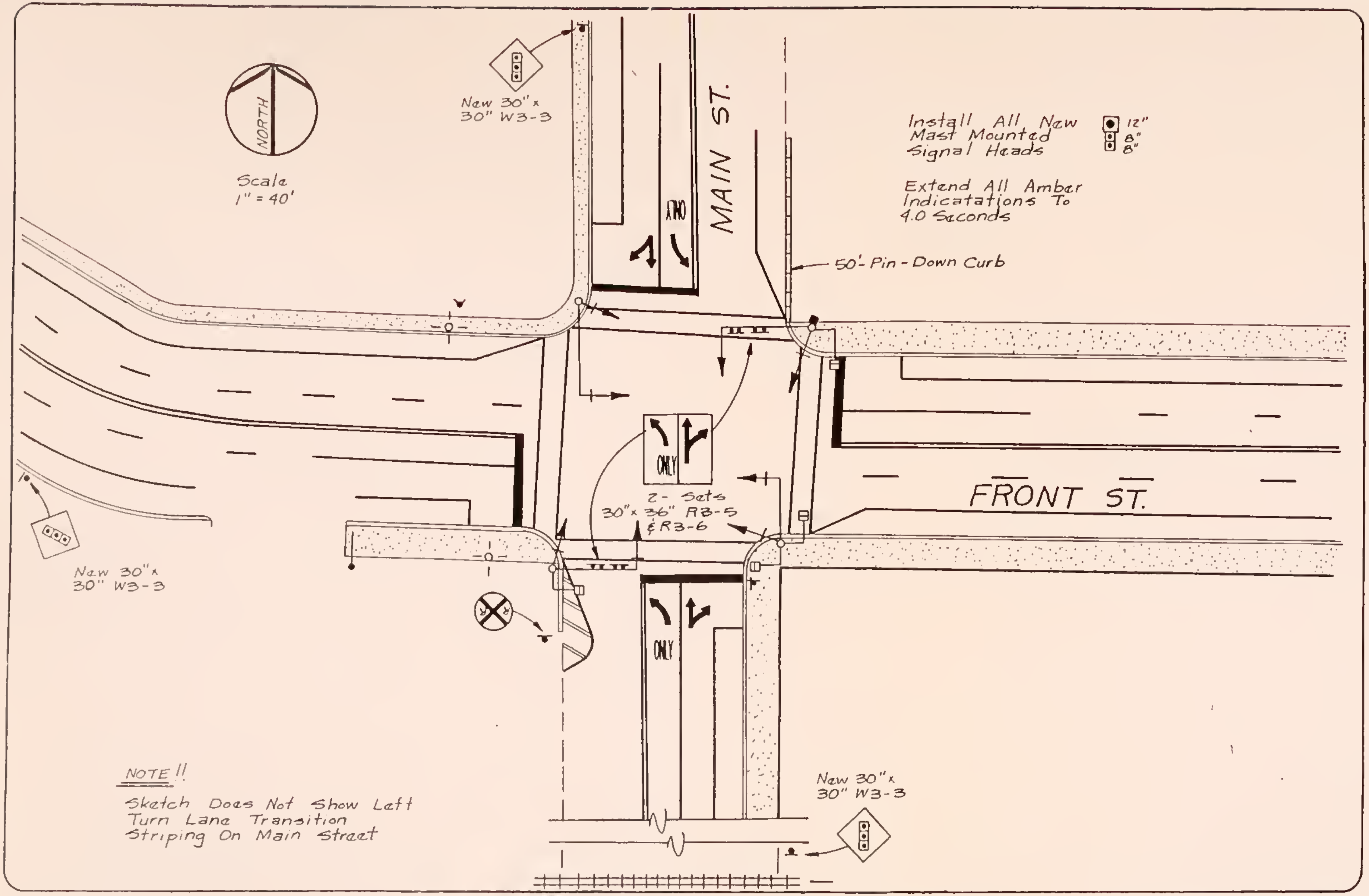
prepared by Christiien, Spring, Sielbech & Associates
MONTANA

Sheet Title: Site No 6
Existing Conditions
Main - Front

Survey Book No
Field Work by
Designed by
Drawn by
Checked by
Date

Client No
Project No

Sheet No
of



prepared by Christian, Spring, Sielbach & Associates
MONTANA
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HAVRE
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Sheet Title: Site No. 6
Short Term Improvements
Main - Front

SITE 7

SITE NUMBER 7

FARRAGUT AVENUE - COBBAN STREET

LOCATION DESCRIPTION

The intersection of Farragut and Cobban is located in an area of Butte commonly known as the "Flats". Farragut Avenue is a north-south collector street serving the residential area of Butte, and Cobban Street is an east-west collector street with its east terminus at LaFayette Street and its western terminus at Kaw Avenue.

EXISTING CONDITIONS

Geometrics. The Existing Condition Sketch Outlines the existing topography of the area. The approach street grades at the intersection are mild and the intersection in plan view is a four-legged intersection with all legs intersecting at right angles. The immediate intersection area, although located in a residential area, is surrounded with commercial development. In the northwest quadrant is a small shopping center, in the southeast quadrant there is a laundromat and stores. The intersection has recently (within the past year) been upgraded to include curb, gutter, and sidewalk. The dashed lines on the existing sketch indicates the approximate pavement width. However, the commercial establishments in the area have paved parking lots and approaches matching street grades which provides access to their paved parking lots. No parking restrictions were noted during the field investigation.

Signalization. Through the upgrade project, signalization of the intersection according to current design standards was accomplished. The intersection is controlled by an Econo-Lite, electro-mechanical, fixed time controller. There is not a separate pedestrian phase for this intersection and the minimum green times are 25 seconds for Farragut Avenue and 19 seconds for Cobban Street. Each approach leg has a 3.0 second amber clearance with no overlap. All signal heads have 8-inch lens and all pedestrian signal heads have 5-inch letters. The 5-inch letters on the pedestrian heads are considered excessive for the geometric conditions at the intersection since MUTCD requires 5-inch letters for pedestrian crossings exceeding 80 feet in length. However, use of the larger heads is practical when it is felt the added visibility is necessary.

Signing. There are no signs related to or pertinent to the operation of the intersection in existence.

Pavement Markings. There are no existing pavement markings in or around the location of the intersection.

Traffic Volumes. The figure on the following page shows a summary of turning movement counts taken during a morning hour period. These counts were taken to establish relative volume and turning movements distribution during the normal daytime activity at the intersection, which is most characteristic of the intersection operation. A December 1979 24-hour automatic count was taken which established the average daily traffic (ADT). From these counts the north-south entering traffic at the intersection was computed as 6430 and the east-west entering traffic was determined to be 4360 ADT. The Montana Department of Highways does not have permanent or annual line count stations near this intersection, therefore no counts for 1977 and 1978 were available.

GRAPHIC SUMMARY OF VEHICLE MOVEMENTS

Observer Ken Behling Date 11/15/79 Day Thursday

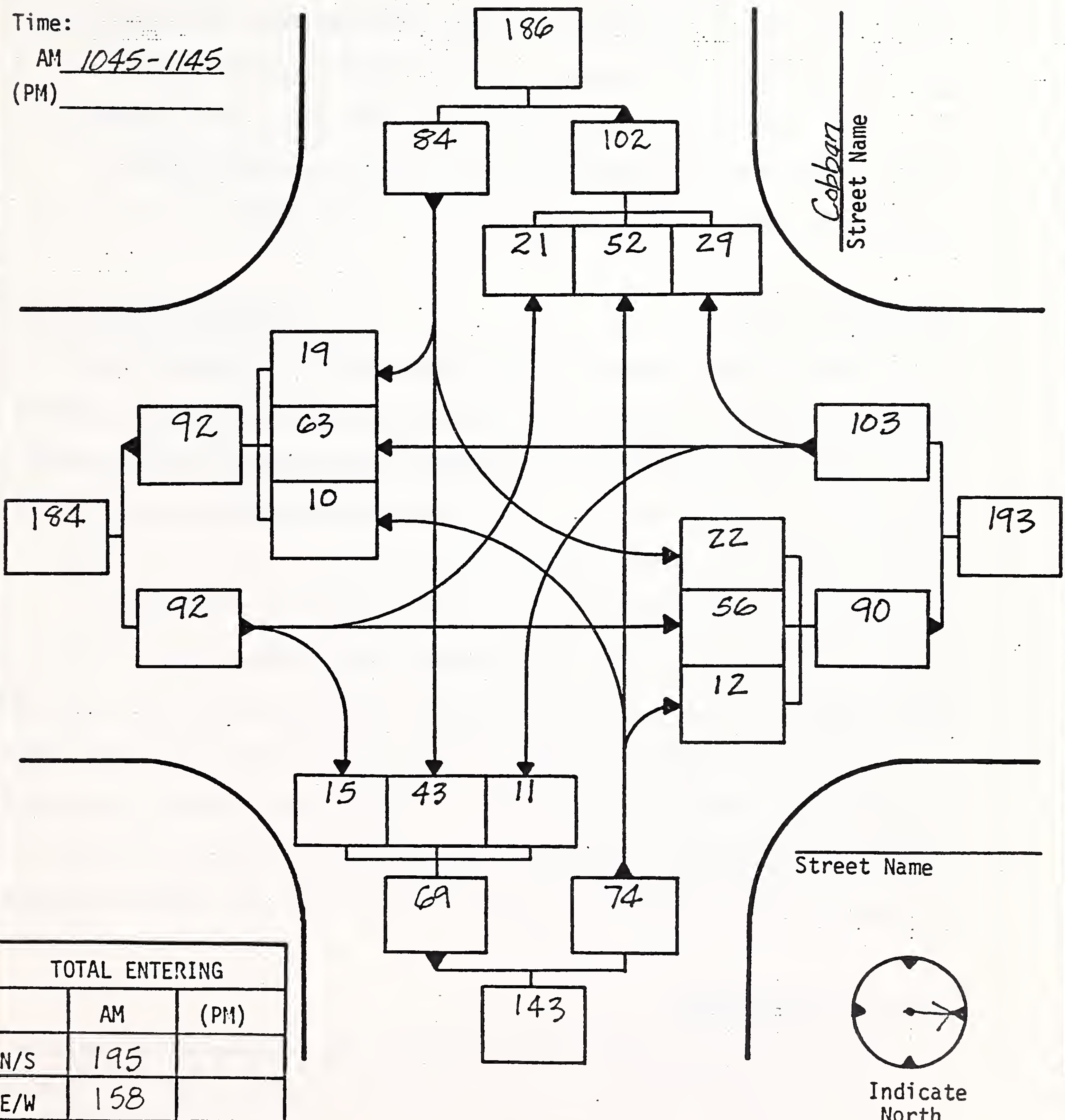
Intersection of Farragot and Cobban

City Butte Montana

Time:

AM 1045-1145

(PM)



TOTAL ENTERING		
	AM	(PM)
N/S	195	
E/W	158	
Total	353	

CSSA Traffic Form 104

Traffic Operations. The signalized control of the intersection operates quite smoothly, however the lack of approach control to the surrounding business establishments inhibits free movement of through traffic at the intersection area during peak hours. The minimum warrants for signalization have been marginally met, however, seasonal variations would indicate that the signal is unnecessary during some months of the year. Realistically, 24-hour operation of the signal on a fixed time basis is not necessary. Flashing operation during low volume periods would be ideal.

ACCIDENT ANALYSIS

In the three year period from 1975 through 1977 there were 13 reported accidents at this intersection. The Accident Summary Sheet clearly indicates that the majority of accidents occurred during clear weather conditions with dry roads in the daylight hours. The overwhelming majority of accidents were angle accidents and the only other accident types occurring at this intersection were left-turn maneuvers. It is typical that the major type of accident occurring at an intersection whose volumes approach signalization warrants would be angle accidents. Since the intersection had been signalized after the accident reporting period, the value of analyzing the accident data is questionable. However, the analysis of traffic conditions and appropriate traffic control measures is valuable since conditions conducive to future accidents can be eliminated by upgrading to the most recent traffic standards.

SHORT TERM IMPROVEMENTS

The Short Term Improvement Sketch outlines the recommended intersection

control devices necessary to upgrade the intersection to avoid future accident problems. The following are recommended improvements:

1. Pavement markings to delineate lane widths and proper travel paths according to MUTCD Standards are shown in the sketch.

2. Control of parking at all intersection corners by pavement striping is necessary to insure minimum site distance requirements.

3. Modifications to restrict and control approach movements on Cobban Street by the use of pindown curb is considered necessary.

LONG TERM IMPROVEMENTS

The inclusion of Farragut Avenue and Cobban Street in a future transportation system plan for the City of Butte has not been documented. Due to the unavailability of definitive information, positive long-term improvements cannot be recommended at this time.

ECONOMIC BENEFIT

The anticipated accident reductions and related benefits derived from the recommended improvements are calculated below. The method of computation and forecasting accident reduction is detailed in the "Study Methodology" section of this report.

IMPROVEMENTS	ACCIDENTS		REDUCTION	
	Type	% of Total	*% of Type	% of All Accidents
Short Term:	Angle	85	40	34
	Left-Turn	15	10	2
	Total % Reduction of All Accidents			36

BENEFITS (Dollar Values)

(% Reduction) x (Accidents/Year) x (Useful Project Life) x (Average Severity)

Short Term: (0.36) x (4.33) x (5)x(4.308) = $ 43,580

PRELIMINARY COST ESTIMATE

Short Term Improvements

Item	Quantity	Unit	Unit Price	Cost
Pavement Markings (Plastic Overlay)	4600	L.F.	$ 1.75	$ 8,050
Pin-down Curb	675	L.F.	9.00	6,080
	TOTAL			$14,130

* The % Reduction for each type of accident has been estimated at one-half, since improvements reducing accidents at this site were completed prior to the study.

COST BENEFIT RATIO

The cost-benefit ratio is calculated below. The costs do not include Administrative and Engineering nor do they include the annual cost of replacement and maintenance on signing and striping over the 5-year life of the project.

Cost \$/Benefit \$ = 14,130/43,580 = 0.3242

ACCIDENT SUMMARY

SITE NUMBER 7 LOCATION Farragut - Cobban REPORTING PERIOD November 20, 1979

NUMBERS OF ACCIDENTS

MONTH	NO.
JAN.	2
FEB.	1
MARCH	
APRIL	3
MAY	
JUNE	1
JULY	1
AUGUST	
SEPT.	
OCT.	1
NOV.	1
DEC.	3

DAY OF WK.	NO.
SUN.	2
MON.	4
TUES.	2
WED.	1
THUR.	2
FRI.	1
SAT.	1

WEATHER	NO.
CLEAR	11
RAIN	
SNOW	2
FOG	
OTHER	

ROAD CONDITION	NO.
DRY	7
WET	1
SNOWY	1
ICY	4
OTHER	

LIGHT CONDITION	NO.
DAY	8
DAWN OR DUSK	2
DARK LIGHTED	3
DARK UN-LIGHTED	

ACCIDENT TYPE	NO.
ANGLE	11
LEFT TURN	2
REAR END	
HEAD ON	
SIDE SWIPE	
PARKED VEHICLE	
BACKING	
FIXED OBJECT	
PED.	
ANIMAL	

YEAR & SEVERITY	NO.
1974 FATAL	
INJURY	2
PROPERTY DAMAGE ONLY	
1975 FATAL	
INJURY	5
PROPERTY DAMAGE ONLY	2
1976 FATAL	
INJURY	1
PROPERTY DAMAGE ONLY	3

HAZARD INDEX

BASIC COMPUTATIONS

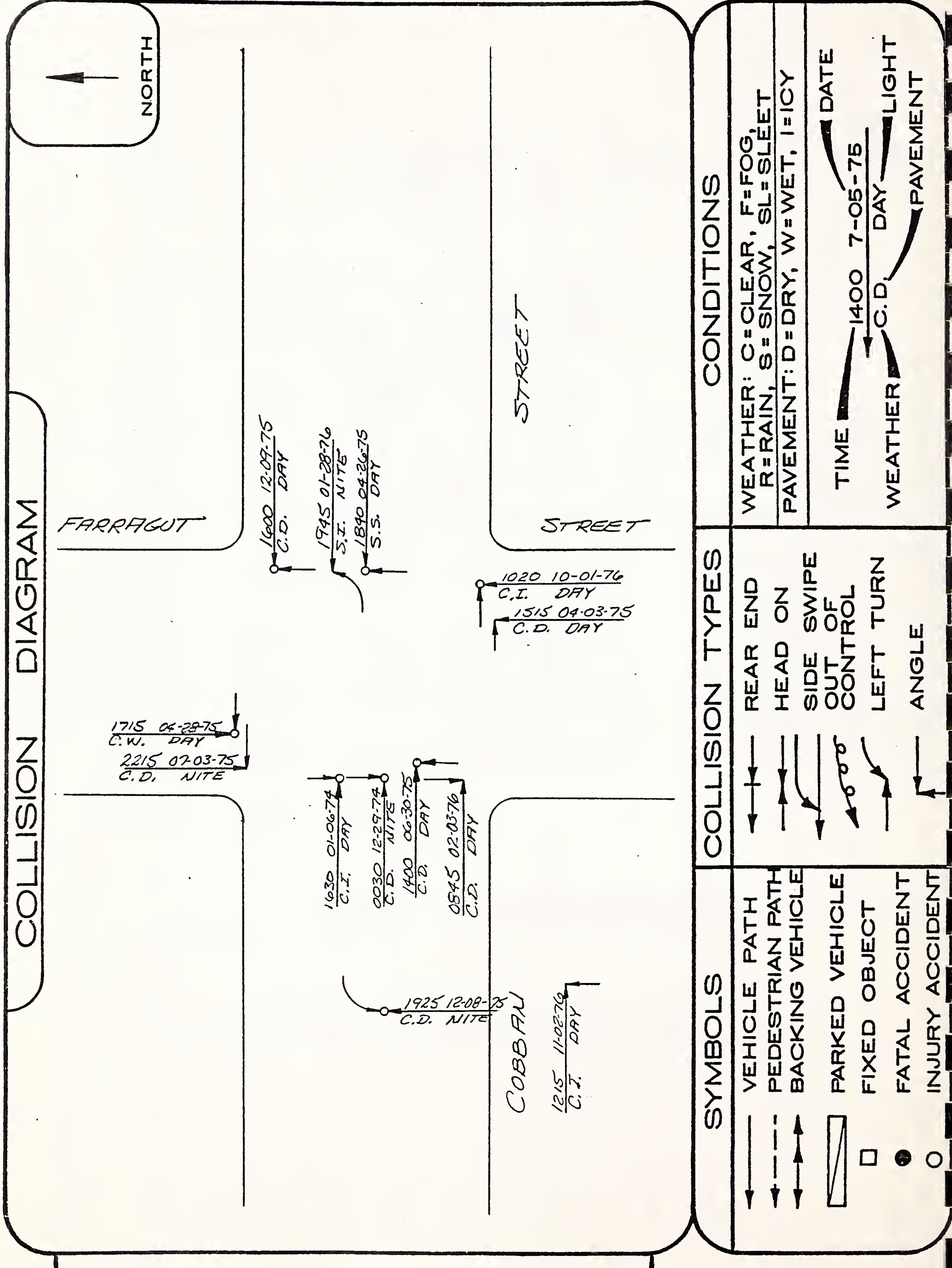
Site Number 7 Date November 20, 1979

Description Farragut - Cobban

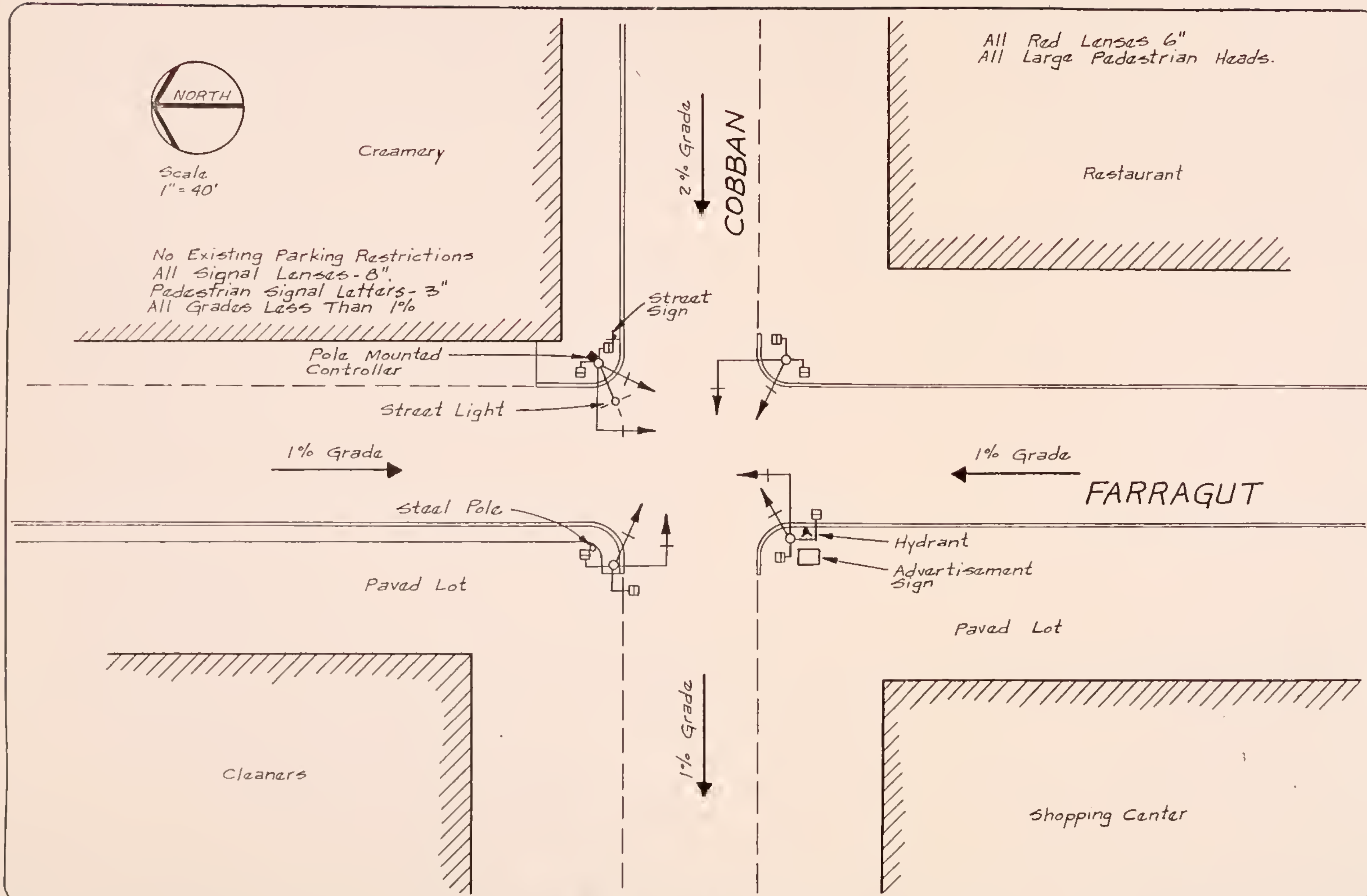
Indicator	Data Value		Indicator Value		Weight		Partial H.I.'s
Number of Accidents	4.33	acc/yr	47	x	0.145	=	6.82
Accident Rate	1.10	acc/MEV	25	x	0.199	=	4.98
Accident Severity	4,308	dollars	46	x	0.169	=	7.77
Volume/Capacity Ratio	0.21		39	x	0.073	=	2.85
Sight Distance Ratio	.45	(wt.avg.)	79	x	0.066	=	5.21
Driver Expectancy	2.8	(wt.avg.)	47	x	0.132	=	6.20
Info. System Deficiencies	2	(wt.avg.)	33	x	0.102	=	3.37
			SUMS:		0.886*		37.20

$$\text{H.I.} = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{37.20}{0.886} = 41.99$$

* The "Erratic Maneuvers" and "Traffic Conflict" indices were omitted from this study. Therefore the weight factors do not total 1.00 and all sites will be ranked on an 88.6% strength of evaluation relative to the FHWA Method.



SITE NO. 7 - FARRAGUT - COBBAN



Revisions No. ... Date

Project

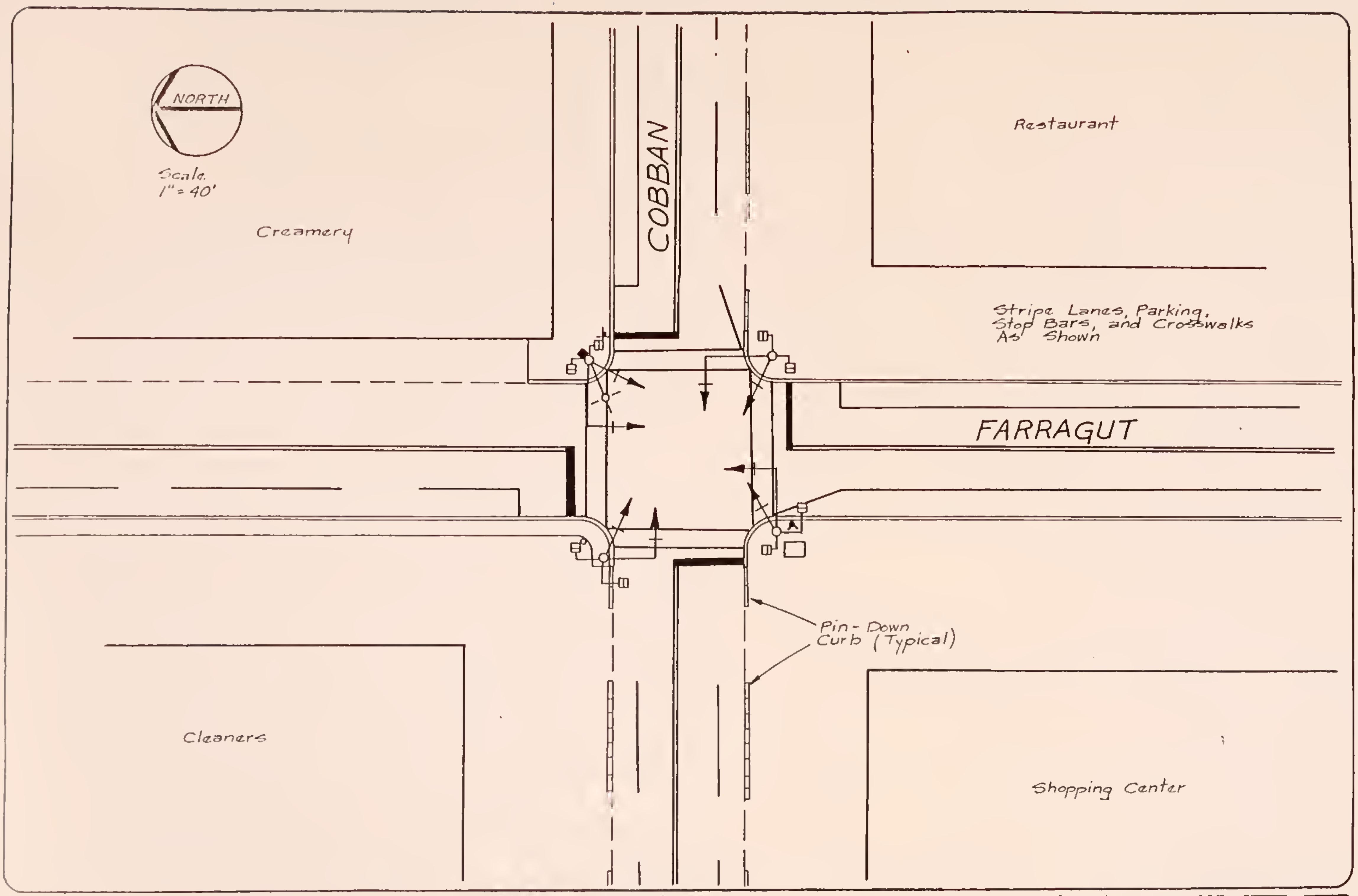
prepared by Christian, Spring, Sielbach & Associates
MONTANA
Consulting Engineering • Surveying • Photogrammetric Engineering

Sheet Title: Site No. 7
Existing Conditions
Farragut - Cobban

Survey Book No.
Field Work by
Designed by
Drawn by
Checked by
Date

Client No.
Project No.

Sheet No.
of



Revisions

Project:

prepared by Christian, Spring, Sielbach & Associates
MONTANA
Consulting Engineering • Surveying • Photogrammetric Engineering

Sheet Title: Site No 7
Short Term Improvements
Farragut - Cobban

Survey Book No
Field Work by
Designed by
Drawn by
Checked by
Date

Client No
Project No
Sheet No
of

SITE 8

SITE NUMBER 8

FARRAGUT AVENUE - OTTAWA STREET

LOCATION DESCRIPTION

The intersection of Farragut Avenue and Ottawa Street is located in the residential fringe area of Butte. Farragut Avenue is a north-south collector street and Ottawa Street is a local residential street.

EXISTING CONDITIONS

Geometrics. The Existing Condition Sketch indicates that Ottawa and Farragut is a right angle, four-legged intersection. Approach grades on all legs are less than one percent. The surrounding features of the intersection include single family housing units with the exception of a multiplex in the northwest quadrant. There are currently no parking restrictions at corners. Curb and gutter is existing on all streets except for the east side of the intersection on Ottawa.

Signing. The only existing signing pertinent to the intersection's operation are stop signs on the approach to Farragut on Ottawa Street.

Pavement Markings. There are no indications of pavement markings on either Ottawa Street or Farragut. Since the intersection has been recently overlaid with a section of bituminous asphalt, it is difficult to determine whether pavement markings existed during the accident reporting period.

Traffic Volumes. The figure on the following page presents a graphic summary of the turning movement volumes during a morning period of the day.

The turning movements were taken to determine the relative distribution of traffic during the normal operation of the intersection. December, 1979 machine counts were taken and an average daily traffic count was established from expansion by daily and monthly variation factors. It was determined that north-south entering traffic volumes were approximately 2150 and east-west entering traffic volumes were 1080.

Traffic Operations. The volume of traffic at the intersection is relatively light and definite conflicts or erratic movements at the intersections were not noted during the field observation. However, it appears that approach traffic on Ottawa Street has restricted sight distance at times due to parked vehicles and other inanimate objects.

ACCIDENT ANALYSIS

In the three-year period from 1975 through 1977 there were 10 reported accidents. The Accident Summary Sheet provides a detailed breakdown of the accident types and conditions. It can be seen from the Summary Sheet that accidents occurred exclusively during clear weather and the majority occurred on dry pavement. The primary type of accident occurring was the angle accident and the only other accident type occurring was that involving a parked vehicle. Since the intersection is not signalized and sight distance restrictions exist, it is not unusual that the predominant type of accident has been the angle accident.

SHORT TERM IMPROVEMENTS

From the Short Term Improvement Sketch it can be noted that signing and striping improvements along with improvements to relieve sight restrictions are recommended. The 36"x36" stop signs are recommended to provide additional visibility for the stop control condition on Ottawa. The striping of centerline

GRAPHIC SUMMARY OF VEHICLE MOVEMENTS

Observer Kent Brewer Date Nov. 15, 1979 Day Thursday

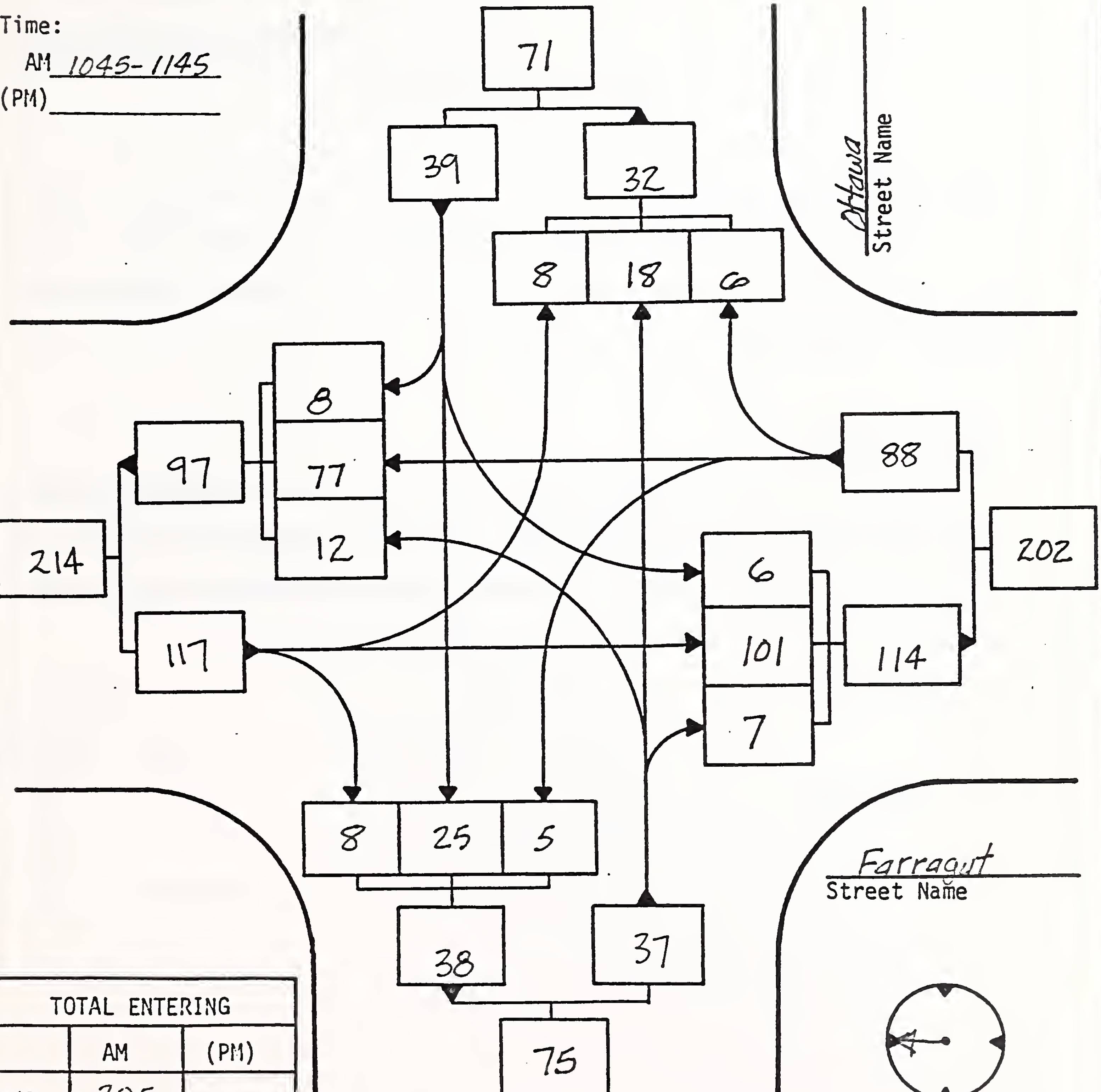
Intersection of Farragut and Ottawa

City Butte Montana

Time:

AM 1045-1145

(PM) ______



TOTAL ENTERING		
	AM	(PM)
N/S	205	
E/W	76	
Total	281	

and parking lanes, including the noted restrictions on all corner locations, will define the correct vehicle path and eliminate errant movements within the intersection proper. Bushes in the southeast quadrant of the intersection should be trimmed to allow additional sight distance. It is advised that enforcement of parking ordinances within the City of Butte be undertaken so that the observed parking habits do not continue.

LONG TERM IMPROVEMENTS

Long term improvements cannot be recommended at this time due to the indefinite character of the intersection as far as the future transportation system is concerned.

ECONOMIC BENEFIT

The anticipated accident reductions and related benefits derived from the recommended improvements are calculated below. The method of computation and forecasting accident reduction is detailed in the "Study Methodology" section of this report.

IMPROVEMENTS	ACCIDENTS		REDUCTION	
	Type	% of Total	% of Type	% of All Accidents
Short Term:	Angle	82	40	33
	Parked Vehicle	18	50	9
	Total % Reduction of All Accidents			42

BENEFITS (Dollar Values)

(% Reduction) x (Accidents/Year) x (Useful Project Life) x (Average Severity)

Short Term: (0.42) x (3.33) x (5) x (3,972) = $27,804

PRELIMINARY COST ESTIMATE

Short Term Improvements

Item	Quantity	Unit	Unit Price	Cost
Pavement Markings (Plastic Overlay)	4800	L.F.	$ 1.75	$ 8,400
Warning Signs	2	Ea.	150.00	300
Trim Bushes	1	L.S.	100.00	100
Total Short Term Improvements Cost				$ 8,800

COST BENEFIT RATIO

The cost benefit calculation is shown below. The cost of maintenance or replacement of signing and pavement markings is not included.

Cost $/Benefit $ = 8,800/27,804 = 0.3165

ACCIDENT SUMMARY

SITE NUMBER 8 LOCATION Farragut - Ottawa REPORTING PERIOD November 20, 1979

NUMBERS OF ACCIDENTS

MONTH*	NO.
JAN.	1
FEB.	
MARCH	
APRIL	1
MAY	1
JUNE	1
JULY	
AUGUST	1
SEPT.	
OCT.	
NOV.	3
DEC.	2

DAY OF WK.*	NO.
SUN.	1
MON.	1
TUES.	2
WED.	1
THUR.	
FRI.	3
SAT.	2

WEATHER*	NO.
CLEAR	10
RAIN	
SNOW	
FOG	
OTHER	

ROAD CONDITION*	NO.
DRY	6
WET	
SNOWY	
ICY	4
OTHER	

LIGHT CONDITION	NO.
DAY	5
DAWN OR DUSK	1
DARK LIGHTED	5
DARK UN-LIGHTED	

ACCIDENT TYPE	NO.
ANGLE	9
LEFT TURN	
REAR END	
HEAD ON	
SIDE SWIPE	
PARKED VEHICLE	2
BACKING	
FIXED OBJECT	
PED.	
ANIMAL	

YEAR & SEVERITY*	NO.
1974 FATAL	
INJURY	
PROPERTY DAMAGE ONLY	1
1975 FATAL	
INJURY	2
PROPERTY DAMAGE ONLY	4
1976 FATAL	
INJURY	1
PROPERTY DAMAGE ONLY	2

HAZARD INDEX

BASIC COMPUTATIONS

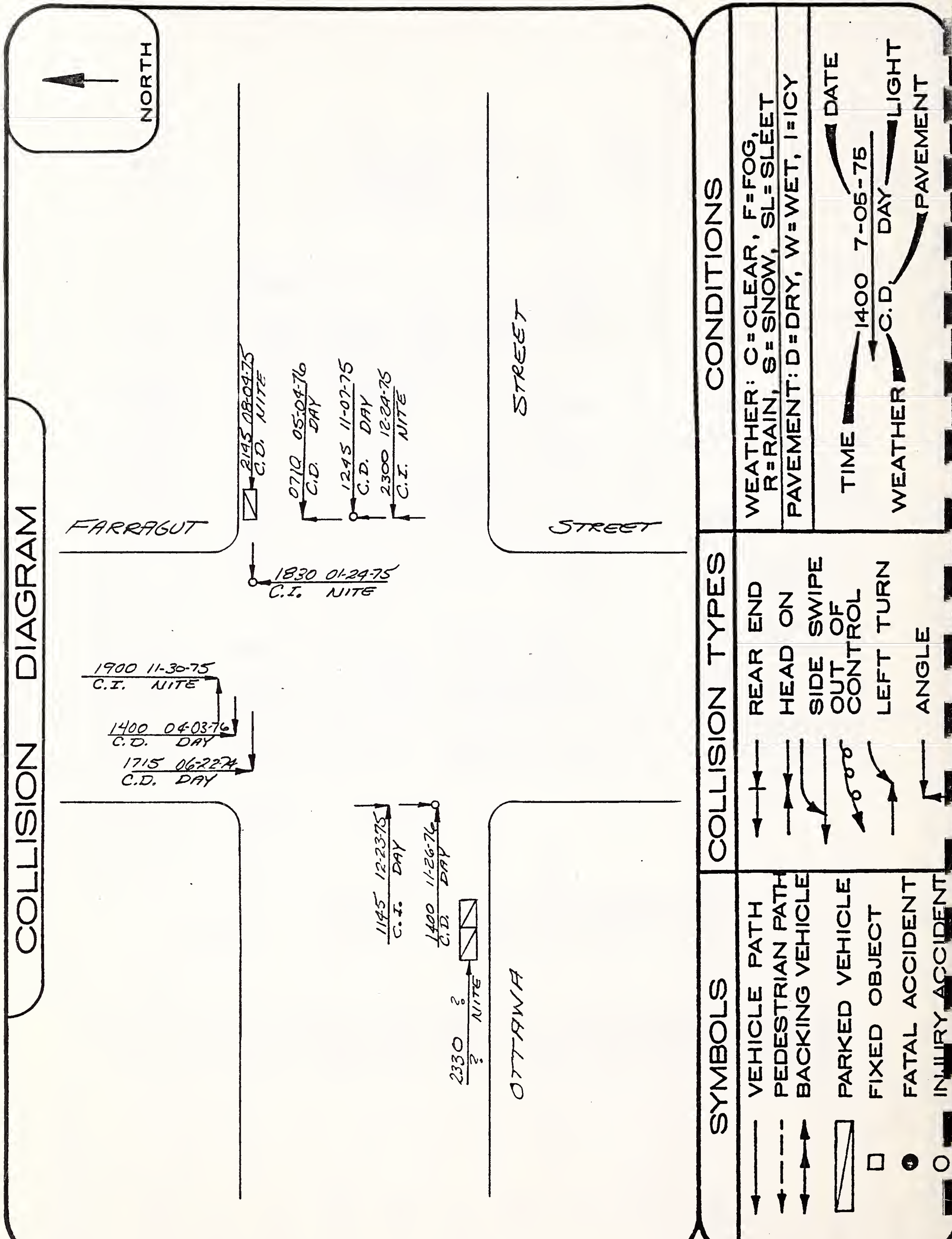
Site Number 8 Date November 20, 1979

Description Farragut - Ottawa

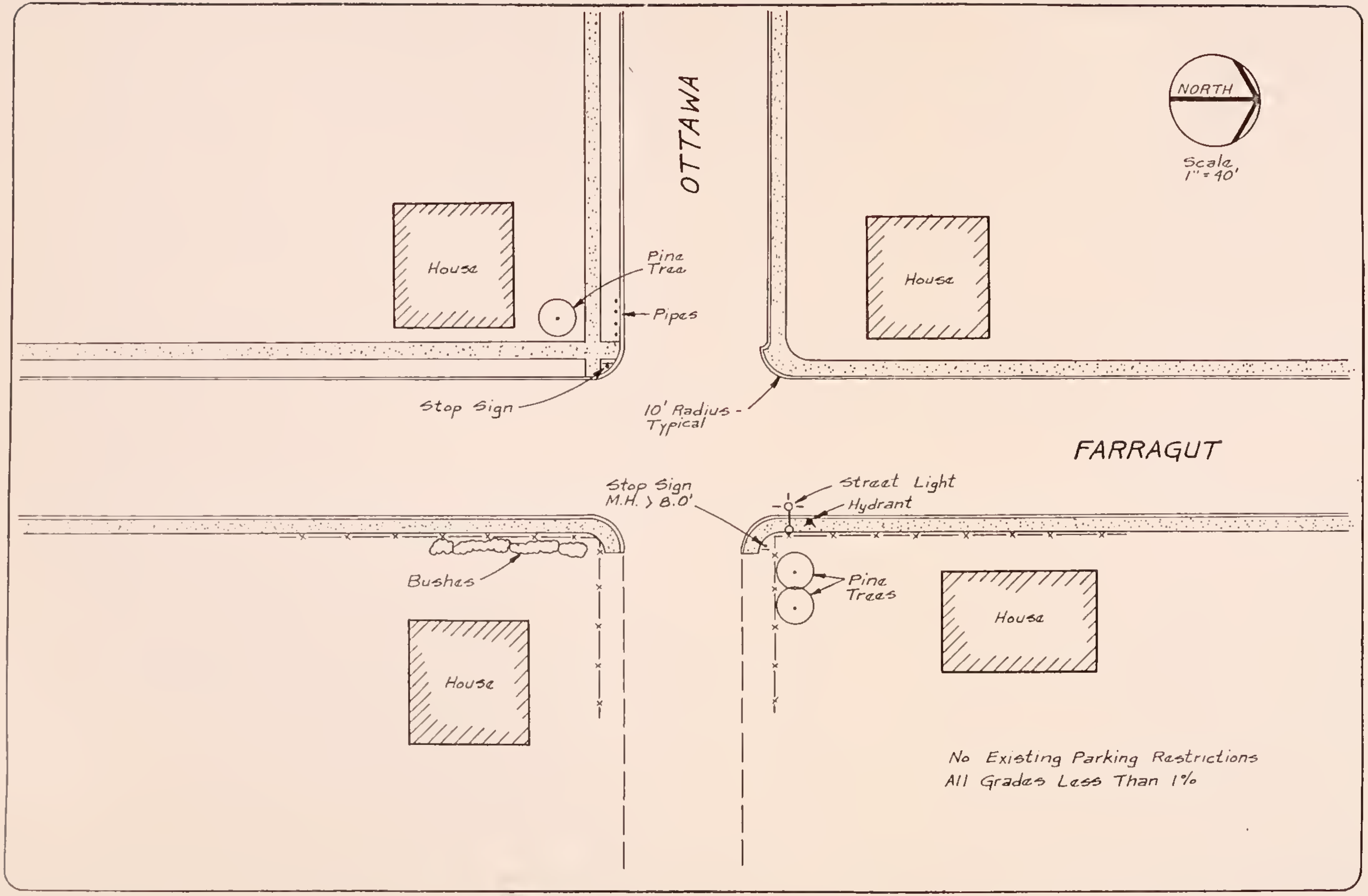
Indicator	Data Value		Indicator Value		Weight		Partial H.I.'s
Number of Accidents	3.33	acc/yr	42	x	0.145	=	6.09
Accident Rate	2.83	acc/MEV	55	x	0.199	=	10.95
Accident Severity	3,972	dollars	44	x	0.169	=	7.44
Volume/Capacity Ratio	0.05		19	x	0.073	=	1.39
Sight Distance Ratio	.31	(wt.avg.)	87	x	0.066	=	5.74
Driver Expectancy	4.3	(wt.avg.)	72	x	0.132	=	9.50
Info. System Deficiencies	3.5	(wt.avg.)	58	x	0.102	=	5.92
			SUMS:		0.886*		47.03

$$\text{H.I.} = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{47.03}{0.886} = 53.08$$

* The "Erratic Maneuvers" and "Traffic Conflict" indices were omitted from this study. Therefore the weight factors do not total 1.00 and all sites will be ranked on an 88.6% strength of evaluation relative to the FHWA Method.



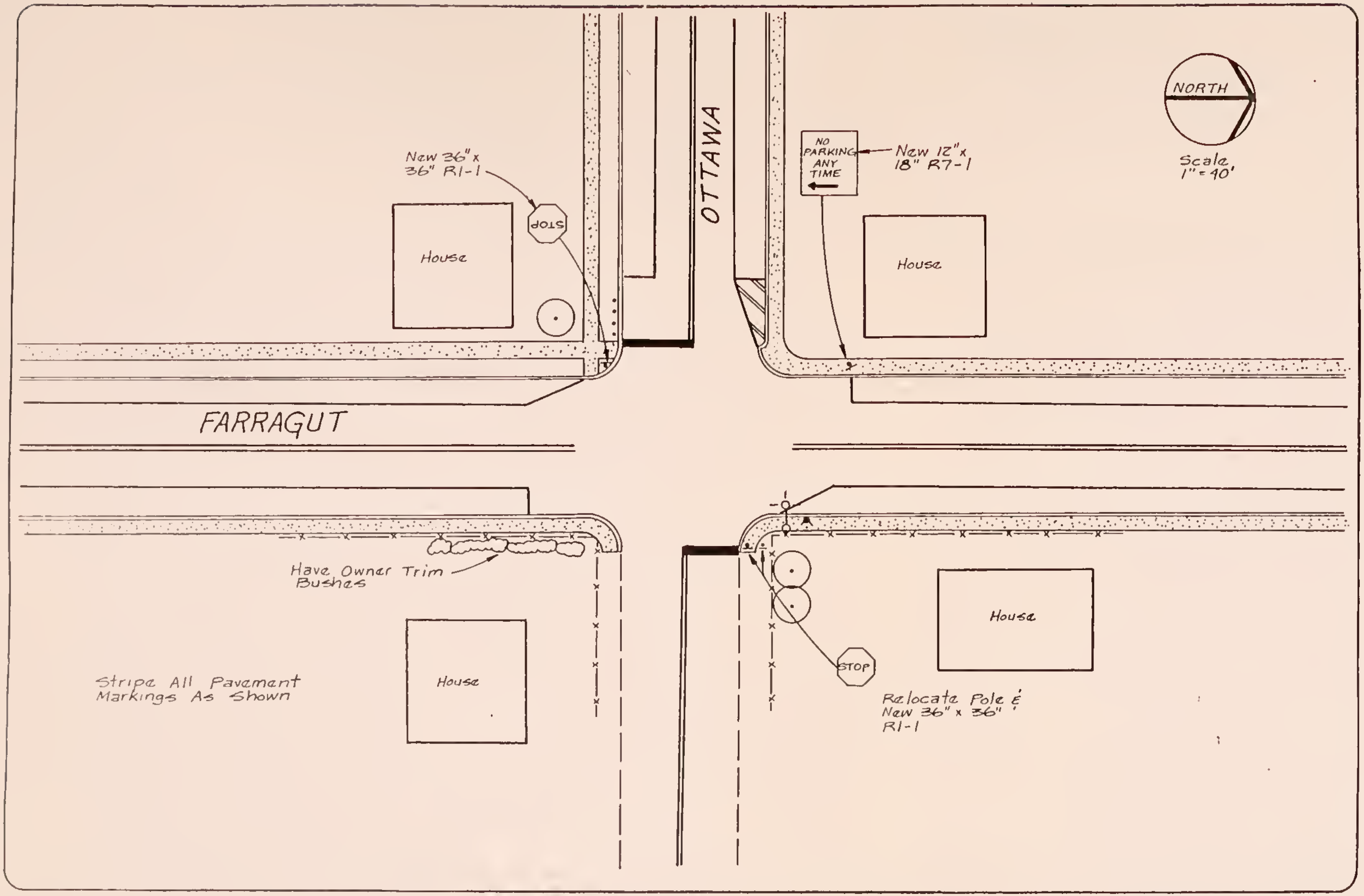
SITE NO. 8 - FARRAGUT - OTTAWA



Project

prepared by Christian, Spring, Sielbach & Associates
MONTANA

Sheet Title: Site No. 8
Existing Conditions
Farragut - Ottawa



prepared by Christian, Spring, Sielbach & Associates
MONTANA
Consulting Engineering • Surveying • Photogrammetric Engineering

Sheet Title: Site No. 8
Short Term Improvements
Farragut - Ottawa

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9

SITE NUMBER 9

EXCELSIOR STREET - PLATINUM STREET

LOCATION DESCRIPTION

The intersection of Excelsior and Platinum is located in the western fringe area of Butte in a primarily residential area. Excelsior Street is a north-south collector connecting to Interstate 15-90 and Platinum is an east-west collector street.

EXISTING CONDITIONS

Geometrics. The Existing Conditions Diagram details all of the existing geometrics and surrounding topography of the area. The approach grades as shown on the sketch on all four approaches to the intersection are relatively steep but within the minimum desirable approach grades for a signalized intersection. The intersection alignment is slightly skewed on the east approach and irregular street widths are not apparent to the average motorist. A church and a house in the northwest and southwest quadrants of the intersection respectively, restrict the sight distance of the intersection somewhat. An unrestricted approach in the northeast quadrant of the intersection provides unlimited access to a beauty shop and a small shopping center. Parking lot spaces along the sidewalk are delineated by pindown curb sections which are flush with the back of a four-foot sidewalk. When parked vehicles align their wheels flush to the pindown curb, the front overhang of the vehicle limits the sidewalk width to one-half foot.

Signalization. The intersection is currently signalized and is controlled by a pole mounted electro-mechanical controller. The signal installation is non-standard according to MUTCD, and consists of a four-way three-color head suspended on wires stretched between service poles at the northeast and northwest quadrants of the intersection. The existing signal timing provides a 22 second green time on Platinum and a 24 second green on Excelsior. Amber clearance intervals for both directions are slightly in excess of 2 seconds. A delay between color indications is apparent and is approximately 0.3 seconds in duration.

Signing. Existing signing includes school warning signs and regulatory "no parking" signs. The intersection is lighted with old style luminaires.

Pavement Markings. Existing pavement markings appear to be standard in location but deficient in coverage. The west leg does not have centerline striping and the stop bars do not extend to the curb lines. Parking lane markings are nonexistent.

Traffic Volumes. The following page is a vehicle turning movement summary for a peak evening hour. The diagram illustrates the heavy right-turn movement from the east approach leg on Platinum along with a significant left-turn movement from that same direction. The other significant turning movement at this intersection is the left-turn movement from Excelsior Street to Platinum Street. The Average Daily Traffic (ADT) expansion of this hourly count produced a north-south entering vehicle movement of 3450 and an east-west entering movement of 2940. 1979 machine counts were made in December of that year which indicated an ADT expansion of 3550 for north-south entering traffic and 3070 for east-west entering traffic. The Montana Department of Highways 1977-1978 average on a count station located south of the intersection on Excelsior Street

GRAPHIC SUMMARY OF VEHICLE MOVEMENTS

Observer R. MARVIN Date Oct. 2, 1979 Day TUESDAY

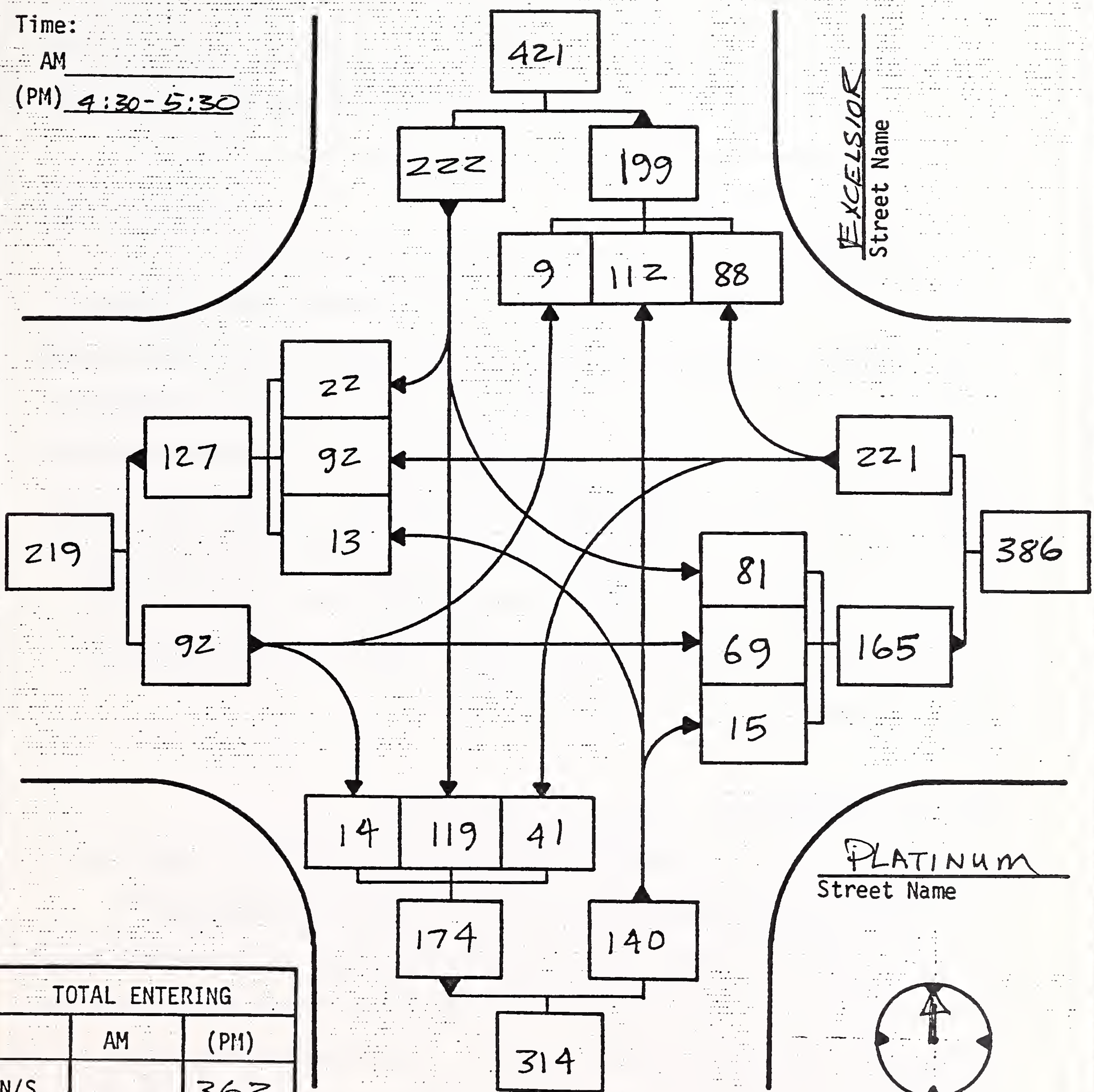
Intersection of PLATINUM and EXCELSIOR

City BUTTE

Time:

AM

(PM) 4:30-5:30



TOTAL ENTERING		
	AM	(PM)
N/S		362
E/W		313
Total		675

produced an ADT of 3450 which correlates quite well with the 1979 ADT expansion.

Traffic Operations. Considering the restricted geometrics and non-standard signalization, the intersection of Excelsior and Platinum operates fairly efficiently. The average headways of the intersection are not ideal due to the tight geometrics and confusing lane designation. In light of the short duration of the amber clearance interval on both legs it is remarkable that a large number of accidents have not occurred at this intersection.

ACCIDENT ANALYSIS

In the two and one-half year period from 1977 through June 1979 there were 11 reported accidents at this intersection. The Accident Summary Sheet presents significant information pertaining to these accidents. It can be seen that the majority of accidents occurred during clear weather on dry road conditions during the daylight hours. The predominant accident type was the angle accident with two left-turn accidents, one accident involving a fixed object and one accident involving a pedestrian. The high number of angle accidents relates to the non-standard signal installation and inadequate clearance interval.

SHORT TERM IMPROVEMENTS

The Short Term Improvements Sketch shows the approximate signal locations included in a recommended upgrade project to comply with current MUTCD standards. These standards are the minimum required to be in compliance with current technology. Striping and signing features of these improvements are noted on the improvement sketch. Included in the signalization project is the addition of luminaires on the signal standards at both the northwest and southeast corners.

LONG TERM IMPROVEMENTS

Due to the lack of definite planning data which would indicate the future system requirements at this intersection, it is not possible to recommend long term improvements at this time.

ECONOMIC BENEFIT

The anticipated accident reductions and related benefits derived from the recommended improvements are calculated below. The method of computation and forecasting accident reduction is detailed in the "Study Methodology" section of this report.

IMPROVEMENTS	ACCIDENTS		REDUCTION	
	Type	% of Total	% of Type	% of All Accidents
Short Term:	Angle	69	80	51
	Left-Turn	18	20	4
	Pedestrian	9	90	8
	Total % Reduction of All Accidents			63

BENEFITS (Dollar Values)

(% Reduction) x (Accidents/Year) x (Useful Project Life) x (Average Severity)

Short Term: (0.63) x (4.40) x (20) x (5,564) = $308,470

PRELIMINARY COST ESTIMATE

Short Term Improvements

Item	Quantity	Unit	Unit Price	Cost
Pavement Marking (Plastic Overlay)	4700	L.F.	$ 1.75	$ 8,225
Signs	3	Ea.	110.00	330
Relocate Parking Curb	1	L.S.	1000.00	1,000
Remove Existing Signals and Temporary Traffic Control	1	L.S.	3500.00	3,500
Traffic Signal Installation Complete In Operation	1	L.S.	50000.00	50,000
Total Short Term Improvements Cost				$63,055

COST BENEFIT RATIO

The cost benefit ratio is calculated below. The costs do not include administration and engineering nor maintenance and replacement of the signal. It does include replacement of signing, and pavement markings every 5 years.

Cost \$/Benefit \$ = 88,720/308,470 = 0.2876

ACCIDENT SUMMARY

SITE NUMBER 9 LOCATION Excelsior-Platinum REPORTING PERIOD November 20, 1979

NUMBERS OF ACCIDENTS

MONTH	NO.
JAN.	2
FEB.	1
MARCH	
APRIL	2
MAY	2
JUNE	
JULY	
AUGUST	1
SEPT.	
OCT.	2
NOV.	
DEC.	1

DAY OF WK.	NO.
SUN.	
MON.	4
TUES.	1
WED.	
THUR.	1
FRI.	2
SAT.	3

WEATHER	NO.
CLEAR	10
RAIN	
SNOW	1
FOG	
OTHER	

ROAD CONDITION	NO.
DRY	8
WET	
SNOWY	
ICY	3
OTHER	

LIGHT CONDITION	NO.
DAY	9
DAWN OR DUSK	
DARK LIGHTED	2
DARK UN-LIGHTED	

ACCIDENT TYPE	NO.
ANGLE	7
LEFT TURN	2
REAR END	
HEAD ON	
SIDE SWIPE	
PARKED VEHICLE	
BACKING	
FIXED OBJECT	1
PED.	1
ANIMAL	

YEAR & SEVERITY	NO.
1977 FATAL	
INJURY	
PROPERTY DAMAGE ONLY	4
1978 FATAL	
INJURY	2
PROPERTY DAMAGE ONLY	2
1979 FATAL	
INJURY	2
PROPERTY DAMAGE ONLY	1

HAZARD INDEX

BASIC COMPUTATIONS

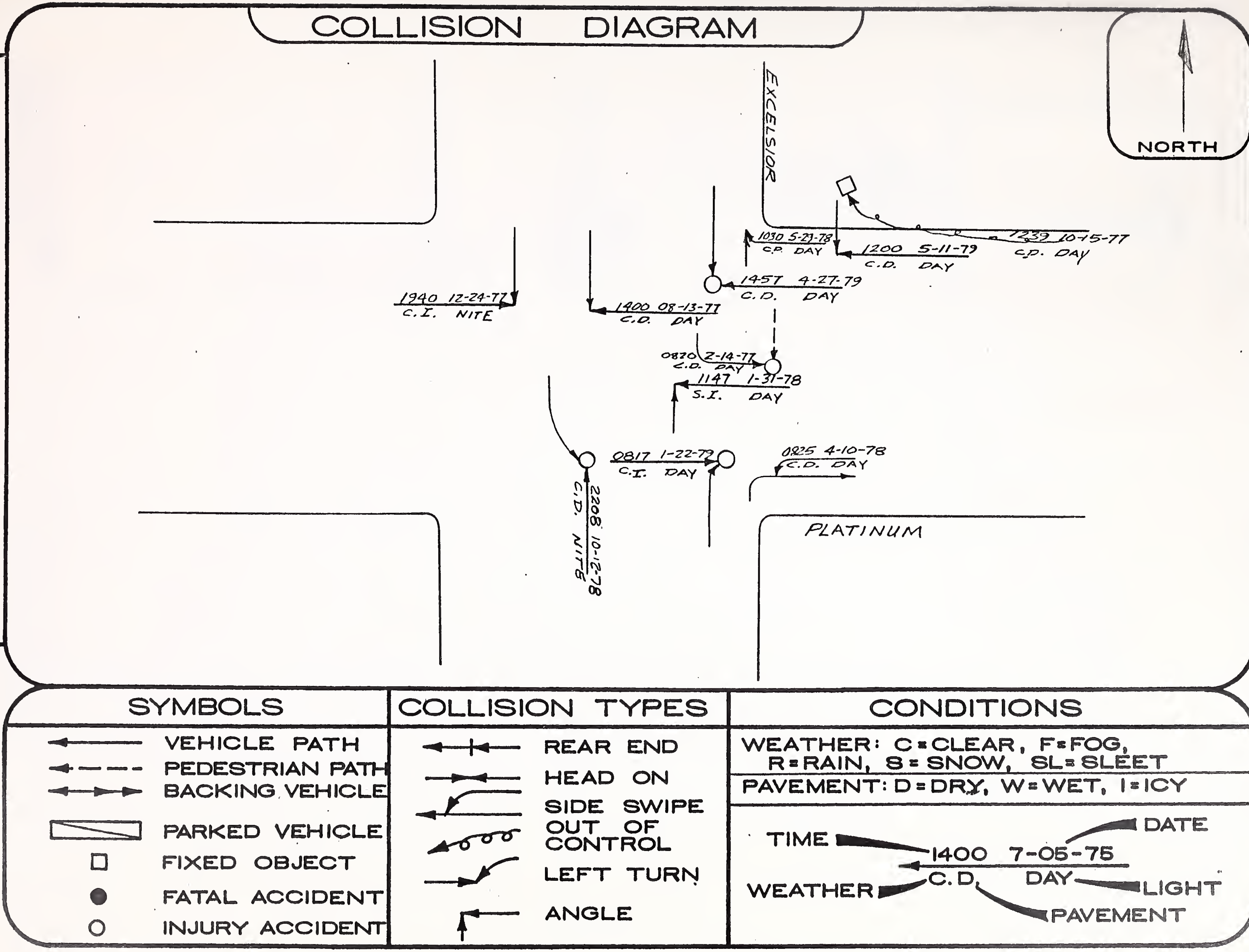
Site Number 9 Date November 20, 1979

Description Excelsior - Platinum

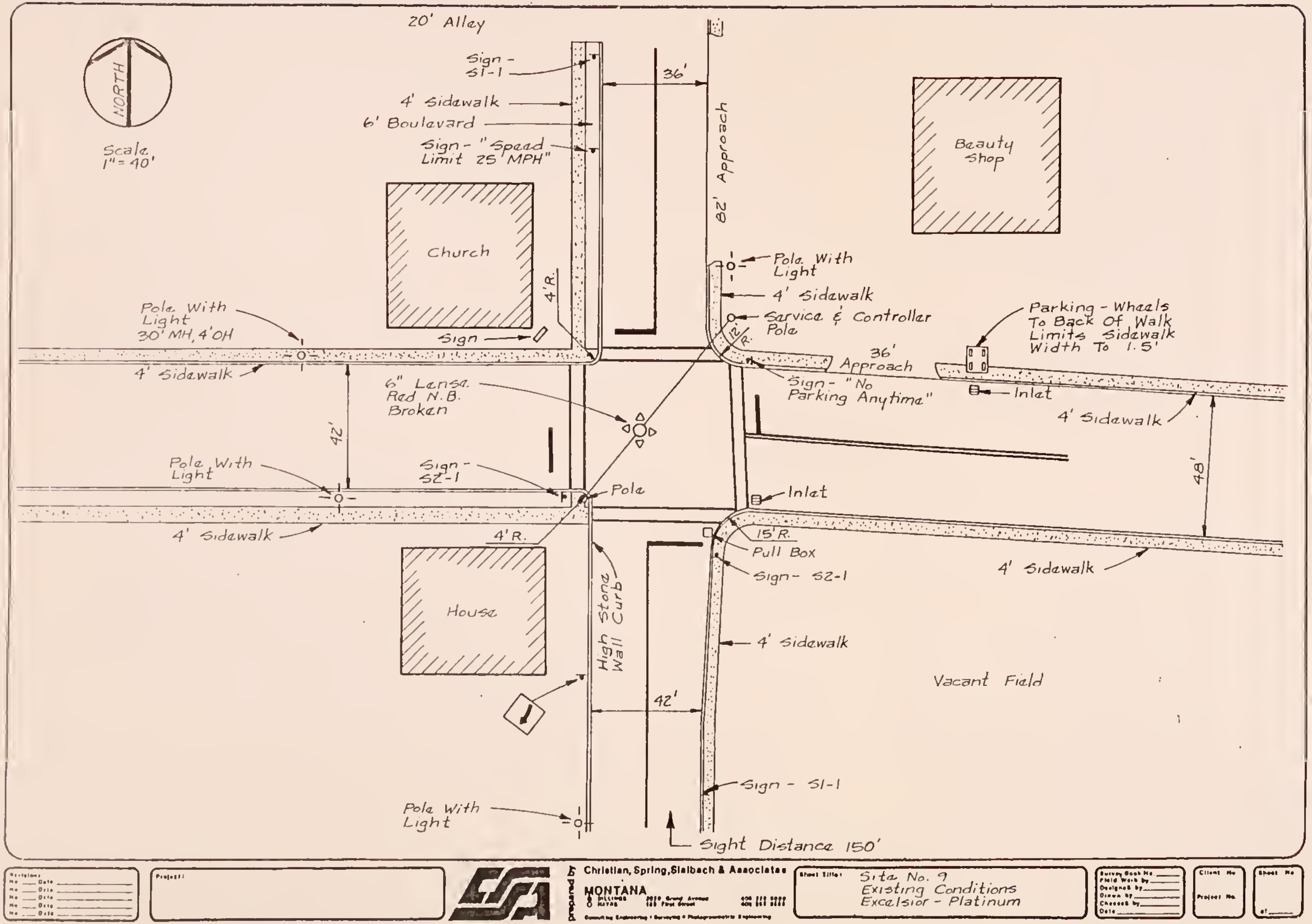
Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	4.4 acc/yr	47	x	0.145	=	6.82
Accident Rate	1.94 acc/MEV	40	x	0.199	=	7.96
Accident Severity	5,564 dollars	50	x	0.169	=	8.45
Volume/Capacity Ratio	.11	28	x	0.073	=	2.04
Sight Distance Ratio	.38 (wt.avg.)	83	x	0.066	=	5.48
Driver Expectancy	4.7 (wt.avg.)	78	x	0.132	=	10.30
Info. System Deficiencies	3 (wt.avg.)	50	x	0.102	=	5.10
		SUMS:		0.886*		46.15

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{46.15}{0.886} = 52.09$$

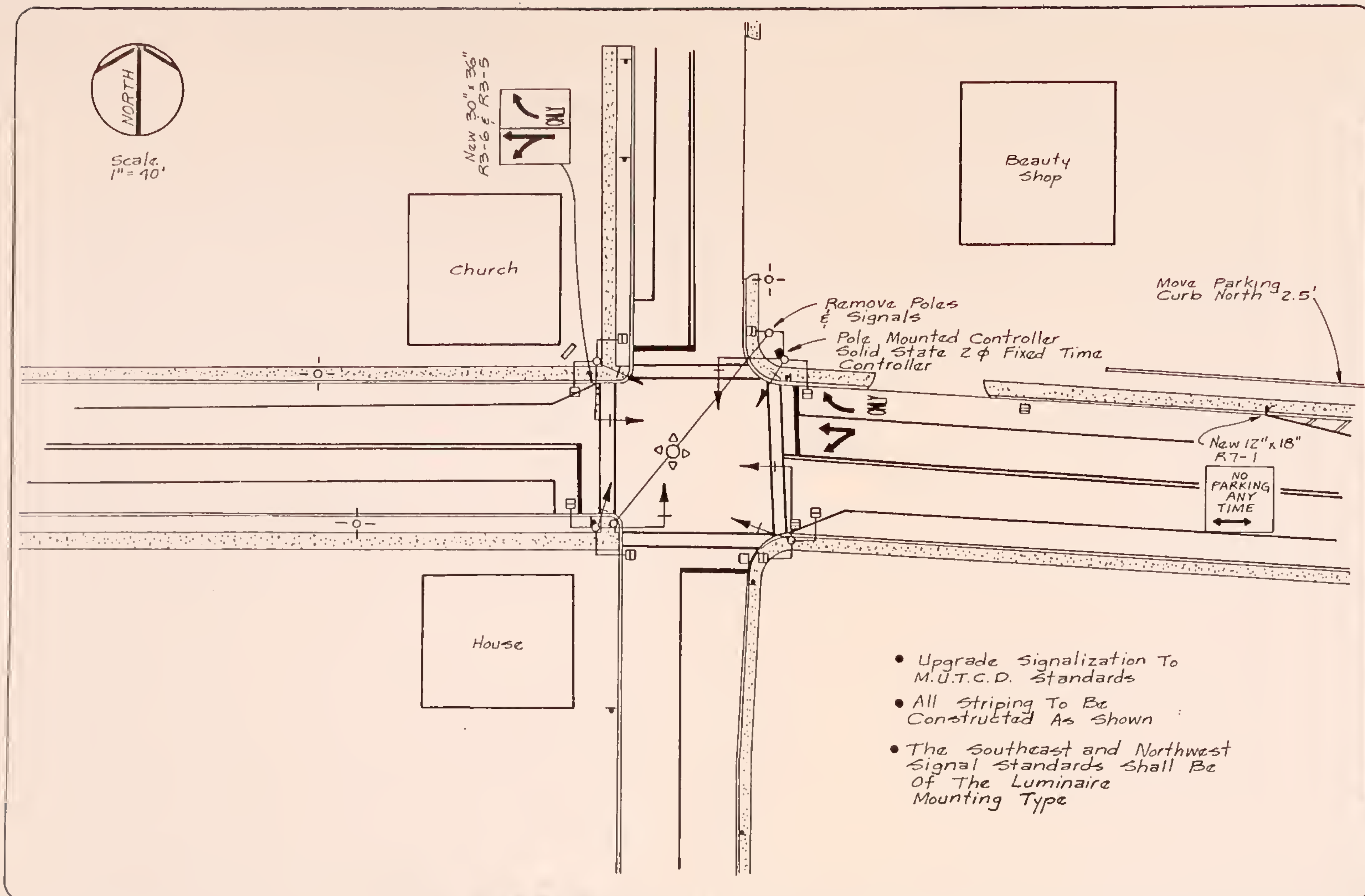
* The "Erratic Maneuvers" and "Traffic Conflict" indices were omitted from this study. Therefore the weight factors do not total 1.00 and all sites will be ranked on an 88.6% strength of evaluation relative to the FHWA Method.



SITE NO. 9 - EXCELSIOR - PLATINUM



NORTH
Scale 1" = 40'
20' Alley
Sign - S1-1
4' Sidewalk
6' Boulevard
Sign - "Speed Limit 25 MPH"
36'
82' Approach
Beauty Shop
Church
4' R.
Pole With Light
4' Sidewalk
Service & Controller Pole
12' R.
Parking - Wheels To Back Of Walk Limits Sidewalk Width To 1.5'
Pole With Light 30' MH, 4' OH
Sign
36' Approach
4' Sidewalk
Sign - "No Parking Anytime"
Inlet
6" Lense Red N.B. Broken
4' Sidewalk
42'
48'
Pole With Light
Sign - S2-1
Pole
Inlet
4' Sidewalk
4' R.
15' R.
Pull Box
4' Sidewalk
Sign - S2-1
House
High Stone Wall Curb
4' Sidewalk
Vacant Field
42'
Sign - S1-1
Pole With Light
Sight Distance 150'
Christian, Spring, Sielbach & Associates
MONTANA
Sheet Title:
Site No. 9
Existing Conditions
Excelsior - Platinum



Revisions No. ___ Date ___

Project:

prepared by Christian, Spring, Sielbach & Associates
MONTANA
Billings 2020 Grand Avenue
Havre 135 First Street
Consulting Engineering • Surveying • Photogrammetric Engineering

Sheet Title: Site No. 9
Short Term Improvements
Excelsior - Platinum

Survey Book No. ___ Field Work by ___ Designed by ___ Drawn by ___ Checked by ___ Date ___

Client No. ___ Project No. ___

Sheet No. ___ of ___

S
I
T
E

10

SITE NUMBER 10

HARRISON AVENUE - OTTAWA STREET

LOCATION DESCRIPTION

The intersection of Harrison Avenue and Ottawa is located in the fringe business district of Butte. Harrison Avenue is a principal north-south arterial and Ottawa is a local street entering Harrison from the east. The west continuation of Ottawa west of Harrison is 'C' Street.

EXISTING CONDITIONS

Geometrics. The Existing Conditions Sketch indicates the geometrics of the intersection of Harrison Avenue and Ottawa Street. As can be seen Ottawa and 'C' street intersect Harrison Avenue at an angle approximately 40 degrees off right angles. There is an existing boulevard, sidewalk, and curb section along Harrison Avenue. However 'C' Street does not have a curb section, sidewalkorshoulder. Ottawa seemingly disects the parking lot between two drive-in restaurants. Since both restaurant parking lots are paved to the edge of the shoulder, the actual delineation between street and parking lot is not well defined. All approach grades at the intersection are less than one percent.

Signing. The only existing signing pertaining to the control of the intersection is a stop sign at the Ottawa approach and a stop sign at the 'C' Street approach. Both stop signs are 30"x30" and are in good condition. In addition to the stop signs are several illegal signs which indicate that the parking lane within the street right-of-way is reserved for customer parking only in front of adjacent businesses.

Pavement Markings. Existing pavement markings are on Harrison Avenue only and are standard in application with the exception of defined restrictions of parking at intersection corners.

Traffic Volumes. The following page illustrates the evening and morning peak hour turning movements at this intersection. The most notable turning movement variation between morning and evening peaks is the Harrison Avenue southbound left-turn movement which increases six-fold in the evening hours. The expansion to Average Daily Traffic (ADT) of these peak hour turning movement counts correlates well with December 1979 automatic machine counts which indicates a north-south entering volume of 17,200 and an east-west entering movement of 770. The Montana Department of Highways 1977-1978 average ADT south of this intersection on Harrison Avenue indicates approximately 18,000 ADT.

Traffic Operations. The intersection operates in an efficient manner throughout most periods of the day. However, the relatively rare occurrence of traffic on Ottawa and 'C' Street seems to create driver expectancy problems when leaving or entering Harrison Avenue at this location. Apparently during the lunch and evening hours the approach traffic to the two drive-in restaurant locations along with the uncontrolled access to these aforementioned establishments, presents maneuverability problems within the parking lots and on the street system.

ACCIDENT ANALYSIS

The Accident Summary Sheet provides a detailed breakdown of the type and condition of accidents over the reporting period. From the Summary Sheet it can be noted that all accidents occurred on clear days with the majority occurring on dry pavement. The majority of accidents also occurred at night.

GRAPHIC SUMMARY OF VEHICLE MOVEMENTS

Observer *Ken Behling* Date *12-6-79* Day *Thursday*

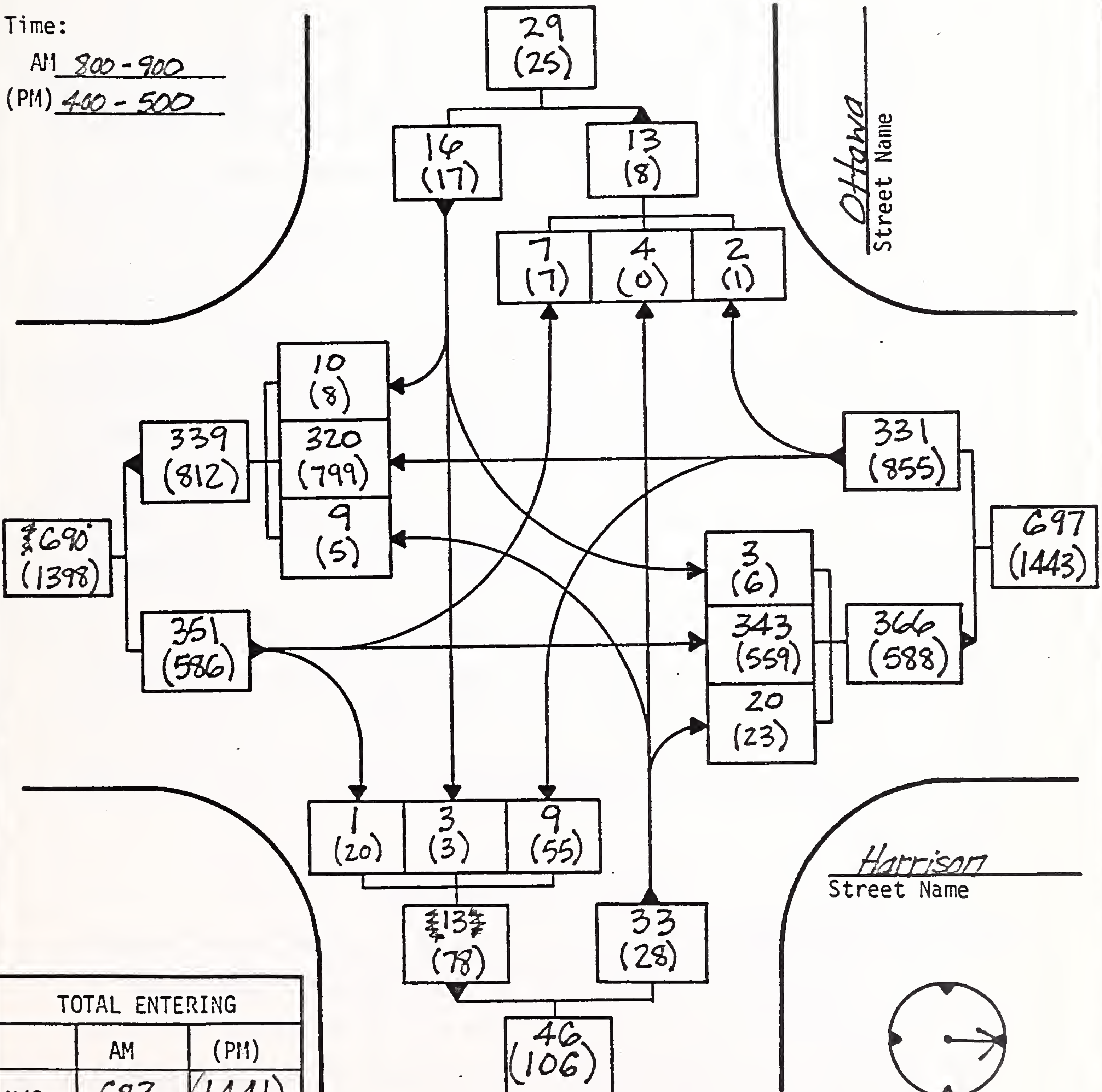
Intersection of *Harrison* and *Ottawa*

City *Butte, Mt.*

Time:

AM *800-900*

(PM) *400-500*



TOTAL ENTERING		
	AM	(PM)
N/S	682	(1441)
E/W	49	(45)
Total	731	(1486)

Indicate North

The major accident type was the rear-end accident. The predominance of the rear-end accident at an unsignalized intersection is unusual. At this location it can be traced to the unexpected approach maneuvers.

SHORT TERM IMPROVEMENTS

The Short Term Improvements Sketch indicates the recommended improvements to this intersection location. Although unexpected approaches combined with the influence from the drive-in restaurants undoubtedly causes the majority of accidents at this intersection, geometric limitations and adjacent land use precludes any major improvements on a short term basis. Therefore it is recommended that Ottawa and 'C' Street be striped to indicate and delineate the proper land usage. Ottawa Street in particular, should be controlled and delineated in a manner that provides no doubt to the motorist the exact positioning of lanes on the approach to Harrison. It is suggested that the approach pattern to the two drive-in restaurants be controlled by pindown curb which may require some changes or modifications to the internal lot circulation of both of these establishments. In addition, parking on Harrison should be restricted at corners and striped to indicate proper control. The illegal customer parking signs should be removed even though there is apparently a limitation of available parking space for customers of these establishments.

LONG TERM IMPROVEMENTS

Due to the insignificant traffic volumes generated on Ottawa and 'C' Street and peaking characteristics of the drive-in restaurant facilities, major long term improvements cannot be recommended at this particular location without including a large section of Harrison Avenue.

Due to the numerous businesses fronting Harrison Avenue and the large amount of approach volume to these businesses with relatively few approach controls, it is recommended that Harrison Avenue change its operation from four lanes with parking on both sides to four lanes with a continuous left-turn lane. This section should extend from Yale Avenue on the southern extremity to George Street on the northern extremity of Harrison Avenue. The limited scope of this report prevents an intensive analysis of these long term improvements.

ECONOMIC BENEFIT

The anticipated accident reductions and related benefits derived from the recommended improvements are calculated below. The method of computation and forecasting accident reduction is detailed in the "Study Methodology" section of this report.

IMPROVEMENTS	ACCIDENTS		REDUCTION	
	Type	% of Total	% of Type	% of All Accidents
Short Term:	Rear-End	73	30	22
	Left-Turn	18	30	5
	Backing	9	90	8
	Total % Reduction of All Accidents			35

BENEFITS (Dollar Values)

(% Reduction) x (Accidents/Year) x (Useful Project Life) x (Average Severity)

Short Term: (0.35) x (4.4) x (5) x (3809) = $29,330

PRELIMINARY COST ESTIMATE

Short Term Improvements

Item	Quantity	Unit	Unit Price	Cost
Pavement Markings (Paint)	8	Gal	$ 50.00	$ 400
Curb and Gutter (In Place)	150	L.F.	$ 12.00	1,800
Pin-Down Curb	450	L.F.	$ 9.00	4,050
Miscellaneous Preparation	1	L.S.	$1000.00	1,000
		Total Short Term Improvements Cost		$7,250

COST BENEFIT RATIO

The cost benefit ratio is calculated below. The costs include the replacement of paint striping two times per year of the 5 year useful life of the project.

Cost $/Benefit $ = 10,850/29,330 = 0.3699

ACCIDENT SUMMARY

SITE NUMBER 10 LOCATION Harrison-Ottawa REPORTING PERIOD November 20, 1979

NUMBERS OF ACCIDENTS

MONTH	NO.
JAN.	2
FEB.	2
MARCH	1
APRIL	
MAY	1
JUNE	2
JULY	1
AUGUST	
SEPT.	
OCT.	1
NOV.	1
DEC.	

DAY OF WK.	NO.
SUN.	1
MON.	1
TUES.	
WED.	2
THUR.	3
FRI.	1
SAT.	3

WEATHER	NO.	ROAD CONDITION	NO.
CLEAR	11	DRY	9
RAIN		WET	1
SNOW		SNOWY	
FOG		ICY	1
OTHER		OTHER	

LIGHT CONDITION	NO.
DAY	3
DAWN OR DUSK	1
DARK LIGHTED	7
DARK UN-LIGHTED	

ACCIDENT TYPE	NO.
ANGLE	
LEFT TURN	2
REAR END	8
HEAD ON	
SIDE SWIPE	
PARKED VEHICLE	
BACKING	1
FIXED OBJECT	
PED.	
ANIMAL	

YEAR & SEVERITY	NO.
1977 / FATAL	
INJURY	
PROPERTY DAMAGE ONLY	3
1978 / FATAL	
INJURY	1
PROPERTY DAMAGE ONLY	2
1979 / FATAL	
INJURY	2
PROPERTY DAMAGE ONLY	3

HAZARD INDEX

BASIC COMPUTATIONS

Site Number 10 Date November 20, 1979

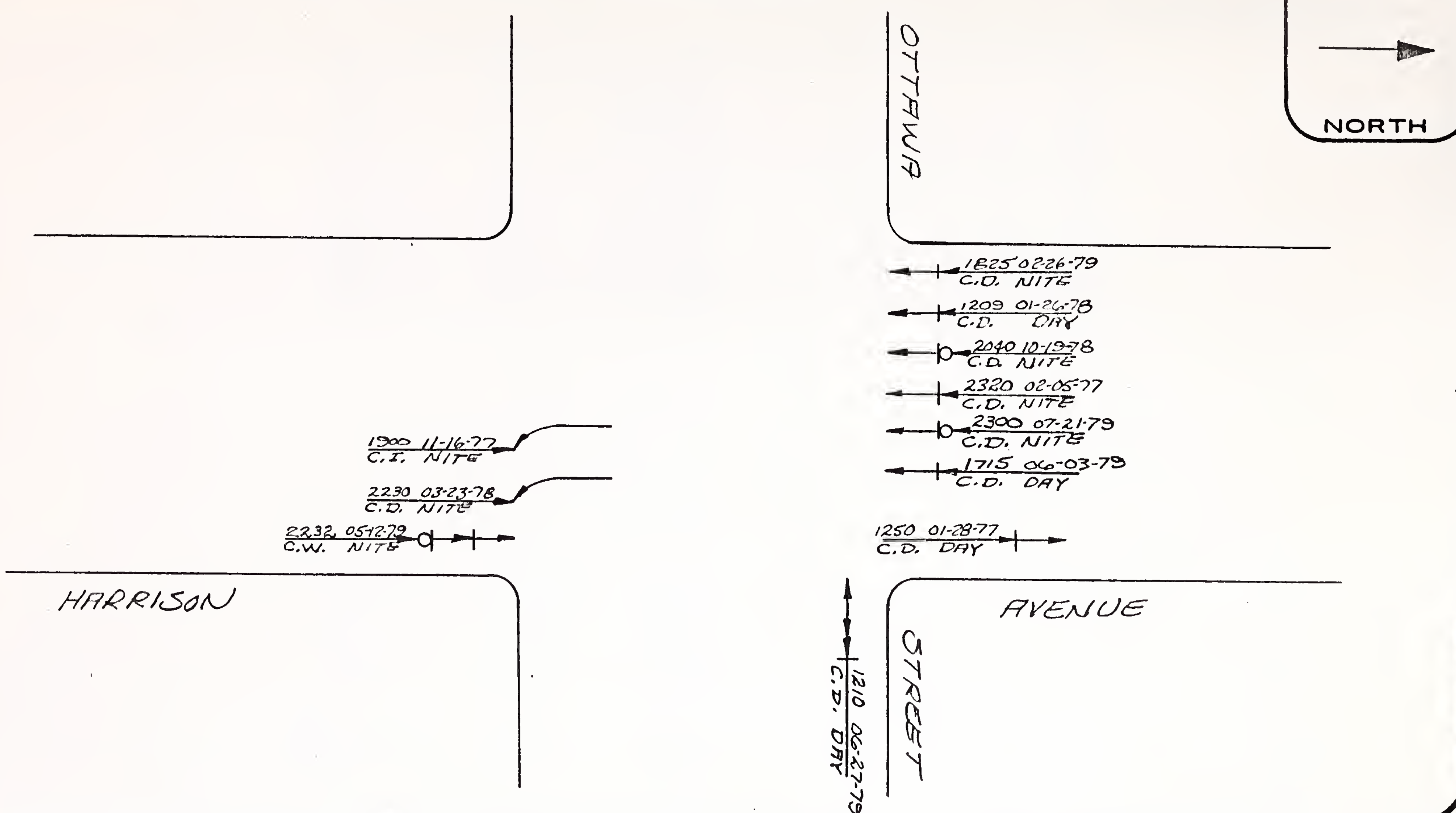
Description Harrison - Ottawa

Indicator	Data Value		Indicator Value		Weight		Partial H.I.'s
Number of Accidents	4.4	acc/yr	47	x	0.145	=	6.82
Accident Rate	0.64	acc/MEV	15	x	0.199	=	2.99
Accident Severity	3,809	dollars	44	x	0.169	=	7.44
Volume/Capacity Ratio	.23		41	x	0.073	=	2.99
Sight Distance Ratio	.46	(wt.avg.)	78	x	0.066	=	5.15
Driver Expectancy	3.7	(wt.avg.)	62	x	0.132	=	8.18
Info. System Deficiencies	3.3	(wt.avg.)	55	x	0.102	=	5.61
			SUMS:		0.886*		39.18

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{39.18}{0.886} = 44.22$$

* The "Erratic Maneuvers" and "Traffic Conflict" indices were omitted from this study. Therefore the weight factors do not total 1.00 and all sites will be ranked on an 88.6% strength of evaluation relative to the FHWA Method.

COLLISION DIAGRAM



SYMBOLS

- VEHICLE PATH
- PEDESTRIAN PATH
- BACKING VEHICLE
- PARKED VEHICLE
- FIXED OBJECT
- FATAL ACCIDENT
- INJURY ACCIDENT

COLLISION TYPES

- REAR END
- HEAD ON
- SIDE SWIPE
- OUT OF CONTROL
- LEFT TURN
- ANGLE

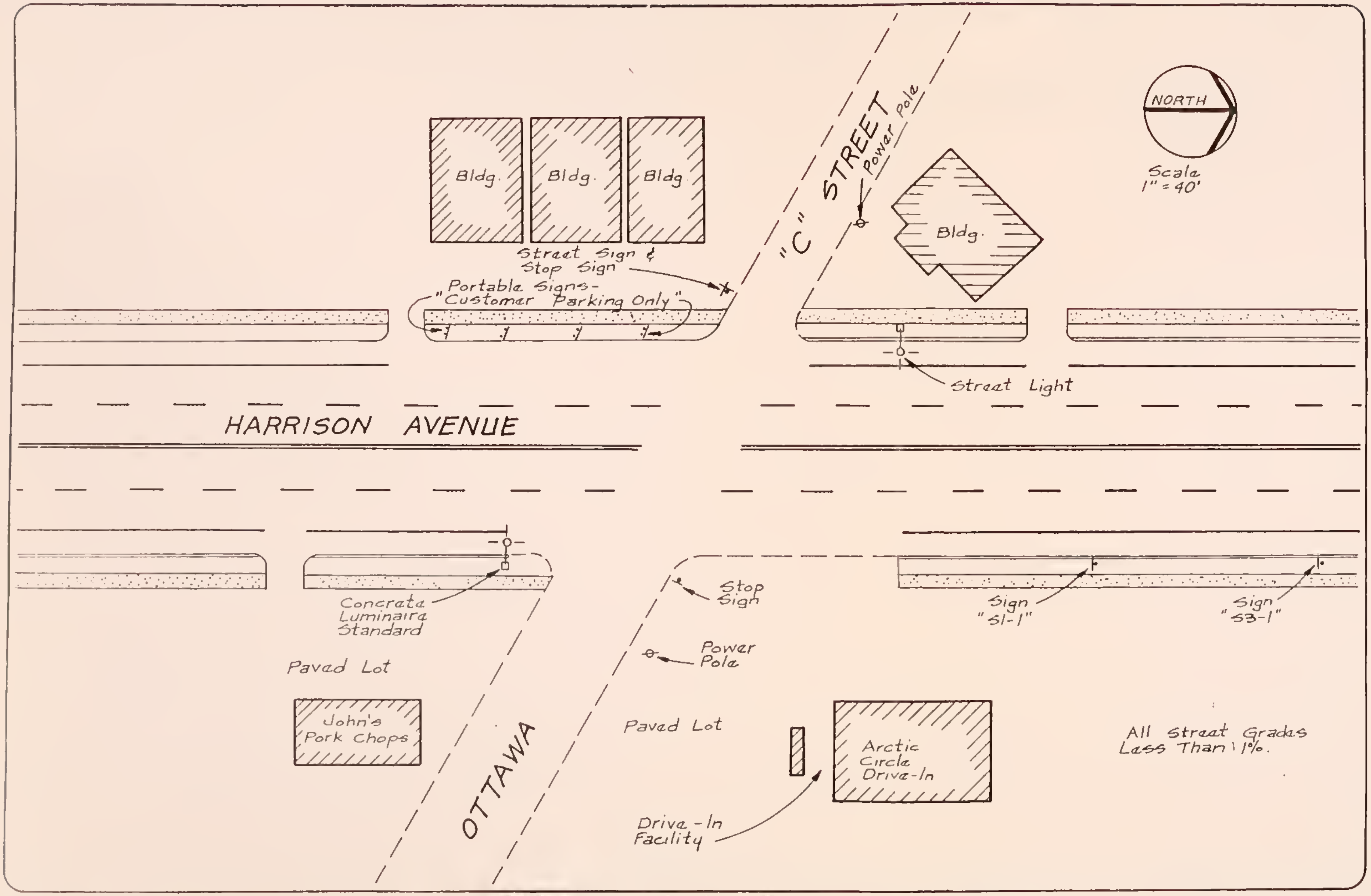
CONDITIONS

WEATHER: C = CLEAR, F = FOG, R = RAIN, S = SNOW, SL = SLEET

PAVEMENT: D = DRY, W = WET, I = ICY

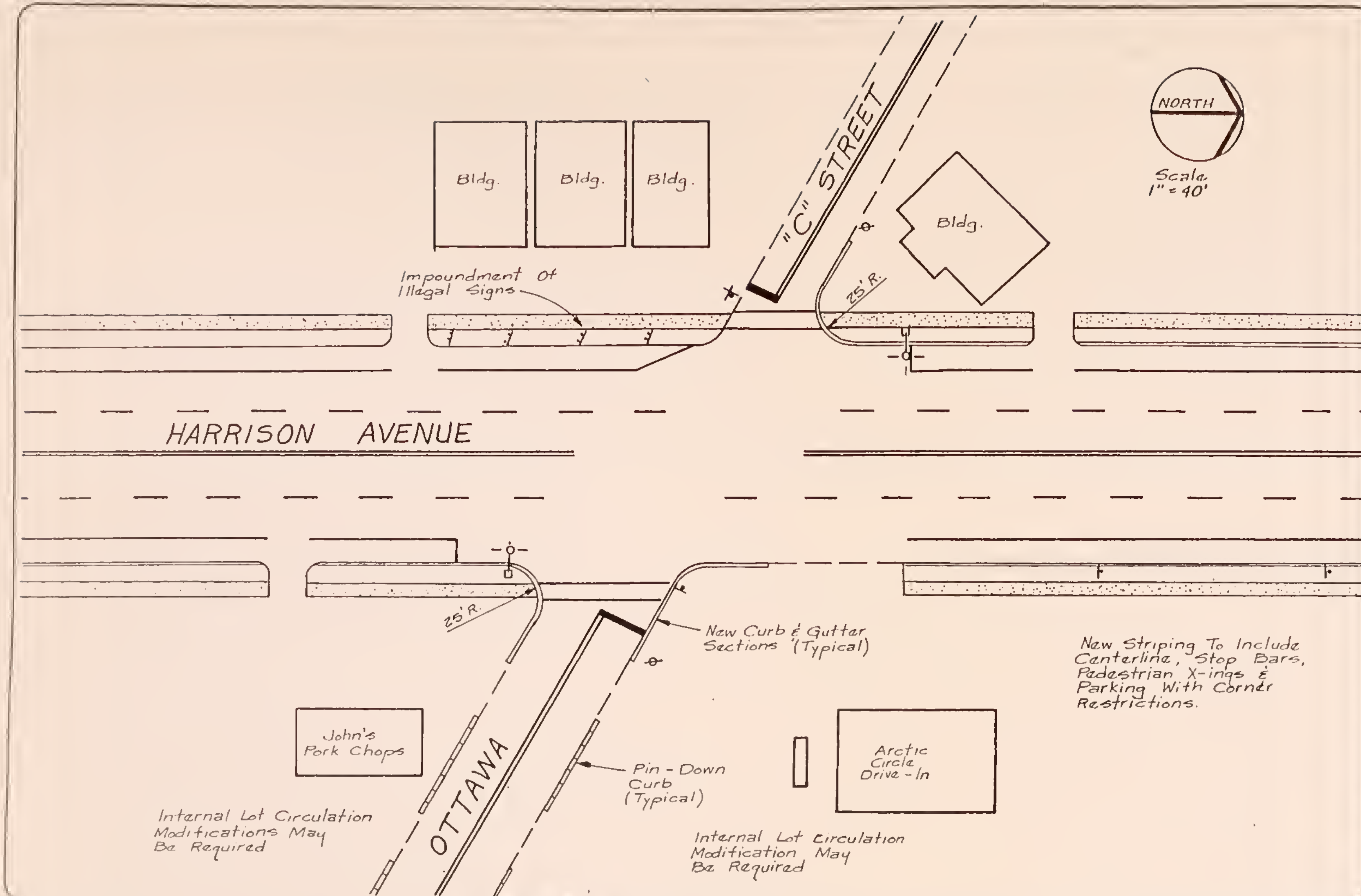
TIME 1400 7-05-75 DATE
WEATHER C.D. DAY LIGHT
PAVEMENT

SITE NO. 10 - HARRISON - OTTAWA



prepared by
Christian, Spring, Sielbach & Associates
MONTANA
BILLINGS
HAVRE

Sheet Title
Site No. 10
Existing Conditions
Harrison - Ottawa



Revisions / Project:

prepared by Christian, Spring, Sielbach & Associates
MONTANA

Consulting Engineering • Surveying • Photogrammetric Engineering

Sheet Title: Site No. 10
Short Term Improvements
Harrison - Ottawa

SITE 11

SITE NUMBER 11

HARRISON AVENUE - GILMAN STREET

LOCATION DESCRIPTION

The intersection of Harrison and Gilman is a "T" intersection located in the fringe area of Butte. A major commercial shopping center access is located 300 feet to the south of the intersection. Harrison Avenue is a principal arterial through the area of Butte known as the "Flats". Gilman Street is a local street with its eastern terminus at Harrison Avenue.

EXISTING CONDITIONS

Geometrics. The Existing Condition Sketch details the intersection geometrics and presents the surrounding topography within the intersection area. Not included on the Existing Condition Sketch is the approach geometrics to the shopping center entrance 300 feet north of the intersection. Presently there is a median island on the south leg of Harrison. The primary purpose of the median is to divide and control the left-turn bay entrance to the shopping center which is located east of Harrison Avenue.

A self-service gas station is located in the southwest corner of the intersection. This gas station generates a significant volume of traffic, in fact, the approach volume to the gas station exceeds the approach volume on Gilman. A building in the northwest corner of the intersection imposes slight sight distance restrictions for the Gilman approach.

Immediately east of the Gilman approach and approximately 80 feet to the south is an approach from the shopping center parking lot. This exit approach is controlled only by pindown curb on the south and the coincidental location of

a power pole and guy wire on the north. The approach width is between 40 and 50 feet wide which allows multiple vehicle departures during peak hour traffic periods.

Signalization. Although the intersection of Gilman and Harrison is not signalized, its operation (to a significant degree) is controlled by the shopping center entrance signal. This signal is a three-phase signal and most applications of control and signal indications are standard. It was observed at various times during peak and non-peak periods that the signal is not entirely responsive to the traffic demands. Minimum and maximum greens appear to be controlled by design hour turning movements with little latitude for off-period adjustment.

Signing. The only existing signing is a speed limit sign (25 mph), a guide sign in the median indicating the shopping center entrance approach and the distance to that approach and regulatory signs indicating lane usage for the shopping center entrance.

Pavement Markings. The pavement markings that do exist are standard. However, there is minimum control over lane usage and parking restrictions by use of pavement markings in this area.

Traffic Volume. The figure on the following page presents a graphic summary of turning movement volumes taken during an evening peak hour on Saturday. The west leg approach includes the volumes for both Gilman and the self-service gas station while the volumes from the approach on the east are representative of traffic volumes from the shopping center exit. Approximately 80 percent of the Gilman Street traffic is directly attributable to the self-service gas station. The expansion of the turning movement counts using hourly, daily, and

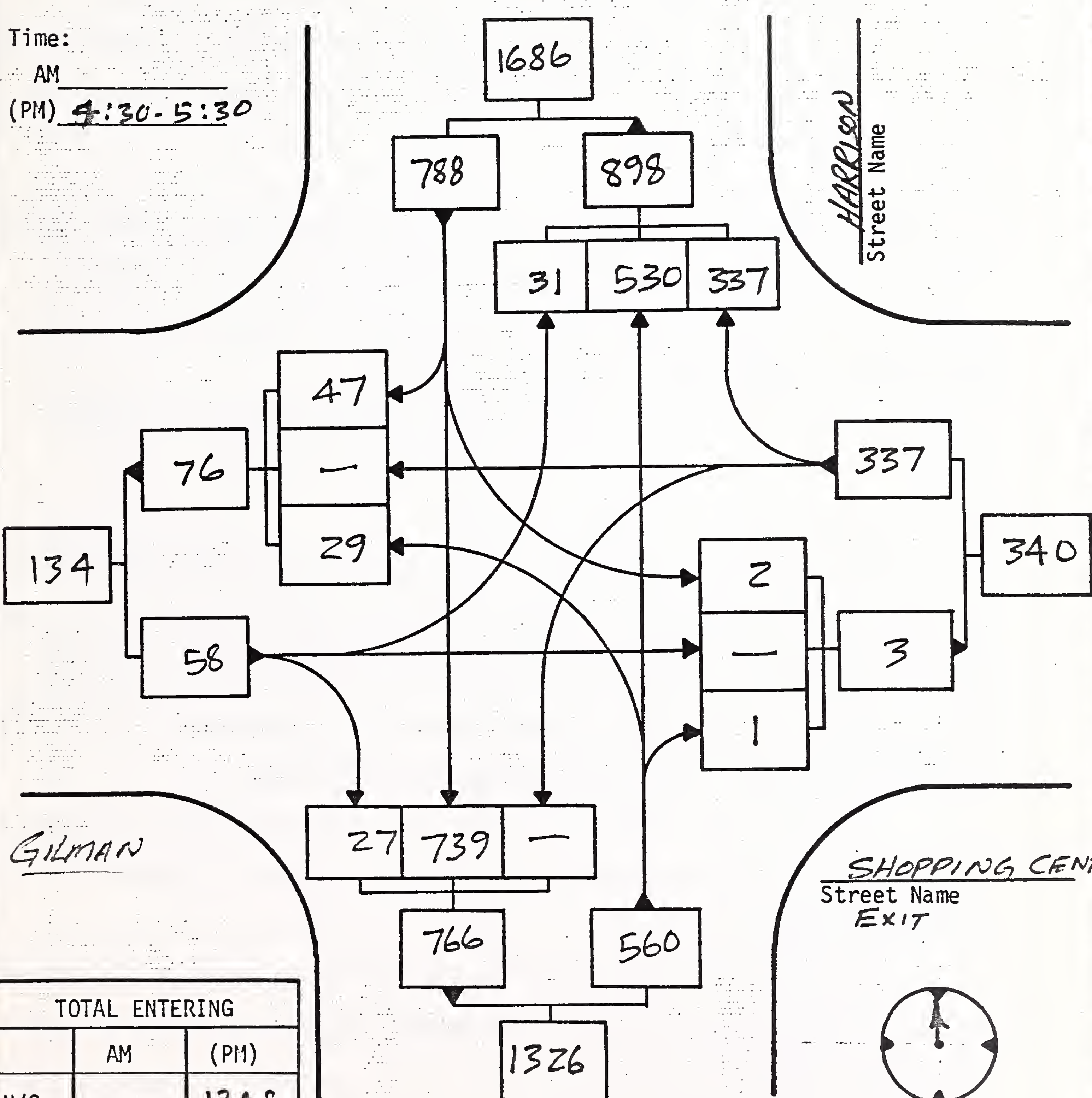
GRAPHIC SUMMARY OF VEHICLE MOVEMENTS

Observer R. MARVIN Date Oct. 22 1975 Day Saturday

Intersection of Gillman and Harrison

City BUTTE

Time:
AM
(PM) 4:30-5:30



TOTAL ENTERING		
	AM	(PM)
N/S		1348
E/W		395
Total		

CSSA Traffic Form 104

monthly variation factors to project an Average Daily Traffic (ADT) resulted in a 1979 Harrison Avenue north-south entering volume of 16,500 vehicles and entering volume from the east-west approaches of 4,840 vehicles. The Montana Department of Highways 1979 traffic counts near this location indicated a Harrison Avenue ADT of 14,980 vehicles. The apparent increase in average daily traffic is not entirely understandable since development in the southern area of Butte has not accelerated.

Traffic Operation. The operation of this intersection can be described as chaotic, at best. This situation can be attributed to the lack of roadside approach control, positive guidance, and inadequate control on adjacent intersections, all combined with large traffic volumes.

Observation of the intersection revealed several separate and distinct maneuvers by motorists, which seemingly recur with predictable frequency. These errant maneuvers are listed as follows:

1. Vehicles exiting the shopping center on the approach east of Harrison cut across two lanes of traffic to make a left turn onto Gilman or to enter the gas station approach. Vehicles on the east exit approach from the shopping center, double or triple side by side and make their exit maneuvers during gaps in traffic which reduces the involved motorists visibility.

2. Cars desiring to avoid the left turn at the signal, drive up the wrong side of the road for a distance of 80 to 100 feet and enter the shopping center at the exit location.

3. Cars entering Harrison from Gilman pull into the center of the roadway in front of the median and wait for gap clearance on Harrison southbound before pulling into traffic.

4. The heavy right turn or what may be considered a merge movement to the gas station entrance is delayed by the internal operation capacity of the service station and thus, cars wait in the street blocking a full lane of traffic.

5. Cars entering the gas station find that they cannot enter the pumps properly from their position and thus enter Gilman Street and proceed back onto Harrison Avenue for a second attempt at a right-turn approach.

6. The unrestricted approach to the gas station allows double or triple exit maneuvers upon entering Harrison.

In addition to the errant maneuvers described above, the left-turn bay capacity for the shopping center is sometimes inadequate to handle all left-turning cars and thus cars backing into Harrison block one of the two lanes. At times, the right-turn movement which is blocked at the gas station eliminates the possibility of any straight through southbound movements on Harrison. An additional concern, is the approach vehicle speeds entering Harrison from the shopping center exits. The vehicle speeds on that approach are sometimes in excess of vehicle speeds on Harrison Avenue.

ACCIDENT ANALYSIS

The Accident Summary Sheet for Site Number 11 details the condition and type of accidents occurring at the intersection of Harrison and Gilman. The majority of accidents occurred in clear weather, on dry pavement and during the night. The clear majority of accidents were of the rear-end type with one angle, one side-swipe and one pedestrian accident. No accidents were reported in 1979.

In view of the chaotic operational conditions at this location, it is surprising that the number of accidents is low and has not been increasing. The occurrence of rear-end accidents is again unusual for an intersection that is non-signalized but in view of the geometric conditions and proximity of the shopping center signal, the contributory cause of these accidents can be readily identified.

SHORT TERM IMPROVEMENTS

The Short Term Improvement Sketch for Site Number 11 outlines the recommended modifications to geometrics, signing, and pavement markings to control some of the errant vehicular movements in the area of this intersection and to allow the interesection to operate in a more efficient manner. Following are detailed explanations of these improvements:

1. New curb and gutter sections should be installed along the front of the self-service gas station to control the access from Harrison. It is suggested that approaches be entrance lanes only and that the exit be on the existing curb cut on Gilman Street. Internal lot circulation improvements may be required to achieve this goal.

2. The existing median island should be modified to provide a left-turn bay for northbound Harrison Avenue traffic onto Gilman Street.

3. A painted median island is required to delineate the left turn to Gilman and left turn from Gilman movements more clearly. Included in this feature is a regulatory directional sign and flexible delineator posts.

4. The existing guide sign, "shopping center exit" should be removed and a sign bridge providing regulatory lane control and positive guidance should be installed.

5. Pindown curb should be used to narrow and define the exit approach from the shopping center. Pavement markings within this stretch indicate a dual left-turn exit maneuver. Also included is a stop bar to define the point that vehicles must stop. The pindown curb should extend into the lot a minimum of 50 feet in order to channelize traffic into the proper approach attitude onto Harrison which will eliminate a skewed high-speed exit across the parking lot.

6. Pavement lane markings should be striped as shown on the Short Term Improvement Sketch to provide clear lane designations and parking areas.

As an additional note to Short Term Improvements, it is recommended that the internal circulation of the shopping center parking lot be studied more carefully since it directly affects traffic flow on Harrison Avenue. It is suggested that an internal road extending into the parking area (at least four lanes in width) be created. The road should extend directly east for a minimum of 150 feet to allow circulation storage within the lot instead of on Harrison Avenue. Also recommended is a dual left-turn lane on Harrison Avenue to avoid queing of cars beyond the left-turn bay storage limits. In addition, the actuation and signal control should be investigated in greater detail to determine optimum operations of the existing signal and its control features.

LONG TERM IMPROVEMENTS

Since the Montana Department of Highways is in the plan and development process of reconstructing Harrison Avenue at this location, it will not be necessary to detail long term improvements. However, it is suggested that the development of plans for the reconstruction of this road section incorporate a detailed traffic operations study to determine the optimum operation of both Harrison Avenue and the shopping center related traffic. Both area and driver characteristics should be incorporated in future design considerations.

ECONOMIC BENEFIT

The anticipated accident reductions and related benefits derived from the recommended improvements are calculated below. The method of computation and forecasting accident reduction is detailed in the "Study Methodology" section of this report.

IMPROVEMENTS	ACCIDENTS		REDUCTION	
	Type	% of Total	% of Type	% of All Accidents
Short Term:	Rear-End	60	70	42
	Angle	10	80	8
	Side-Swipe	10	50	5
	Total % Reduction of All Accidents			55

BENEFITS (Dollar Values)

(% Reduction) x (Accidents/Year) x (Useful Project Life) x (Average Severity)

Short Term: (0.55) x (3.6) x (5) x (5,340) = $52,870

PRELIMINARY COST ESTIMATE

Short Term Improvements

Item	Quantity	Unit	Unit Price	Cost
Pavement Markings (Plastic Overlay)	4,200	L.F.	$ 1.75	$ 7,350
Sign Bridge with signs & illumination	1	L.S.	6500.00	6,500
Signs	2	Ea.	130.00	260
Flexible Delineators	3	Ea.	40.00	120
Modify Median Island	1	L.S.	1500.00	1,500
Curb and Gutter	150	L.F.	8.00	1,200
Pindown Curb	170	L.F.	9.00	1,530
Miscellaneous Reparations	1	L.S.	1000.00	1,000
Miscellaneous Signal Timing Adjustments	1	L.S.	500.00	500
Total Short Term Improvements Cost				$19,960

COST BENEFIT RATIO

The cost benefit ratio is calculated below. Not included in the cost is replacement and maintenance of signs or pavement markings during the 5 year life of the project. Administrative and engineering costs are also not included.

Cost $/Benefit $ = 19,960/52,870 = 0.3775

ACCIDENT SUMMARY

SITE NUMBER 11 LOCATION Harrison - Gilman REPORTING PERIOD November 21, 1979

NUMBERS OF ACCIDENTS

MONTH	NO.
JAN.	
FEB.	2
MARCH	1
APRIL	
MAY	
JUNE	
JULY	
AUGUST	3
SEPT.	
OCT.	
NOV.	1
DEC.	2

DAY OF WK.	NO.
SUN.	
MON.	2
TUES.	2
WED.	1
THUR.	1
FRI.	1
SAT.	2

WEATHER	NO.	ROAD CONDITION	NO.
CLEAR	9	DRY	6
RAIN		WET	1
SNOW		SNOWY	
FOG		ICY	2
OTHER		OTHER	

LIGHT CONDITION	NO.
DAY	2
DAWN OR DUSK	
DARK LIGHTED	7
DARK UN-LIGHTED	

ACCIDENT TYPE	NO.
ANGLE	1
LEFT TURN	
REAR END	6
HEAD ON	
SIDE SWIPE	1
PARKED VEHICLE	
BACKING	
FIXED OBJECT	
PED.	1
ANIMAL	

YEAR & SEVERITY	NO.
1977 FATAL	
INJURY	2
PROPERTY DAMAGE ONLY	1
1978 FATAL	
INJURY	1
PROPERTY DAMAGE ONLY	5
1979 FATAL	
INJURY	
PROPERTY DAMAGE ONLY	

HAZARD INDEX

BASIC COMPUTATIONS

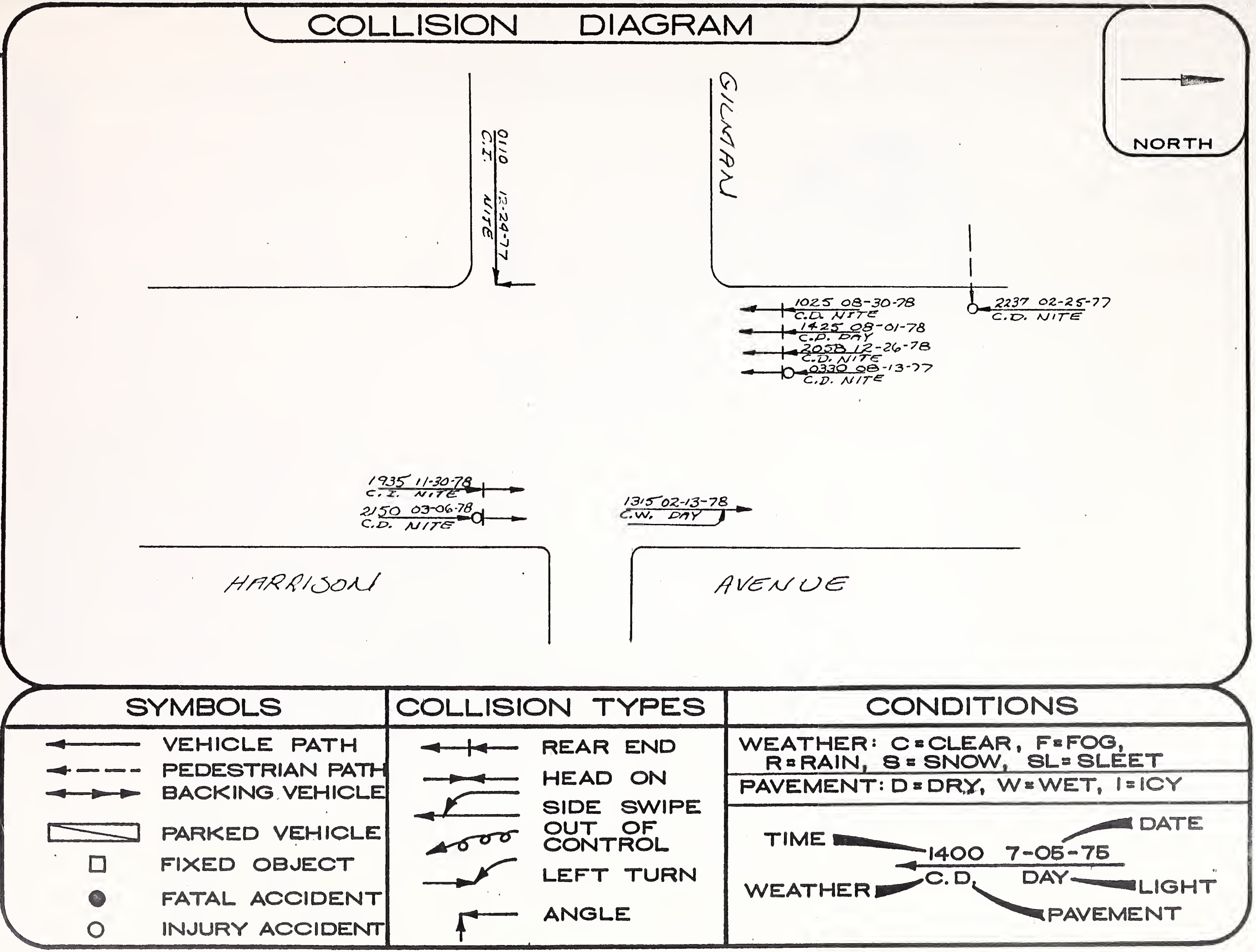
Site Number 11 Date November 21, 1979

Description Harrison - Gilman

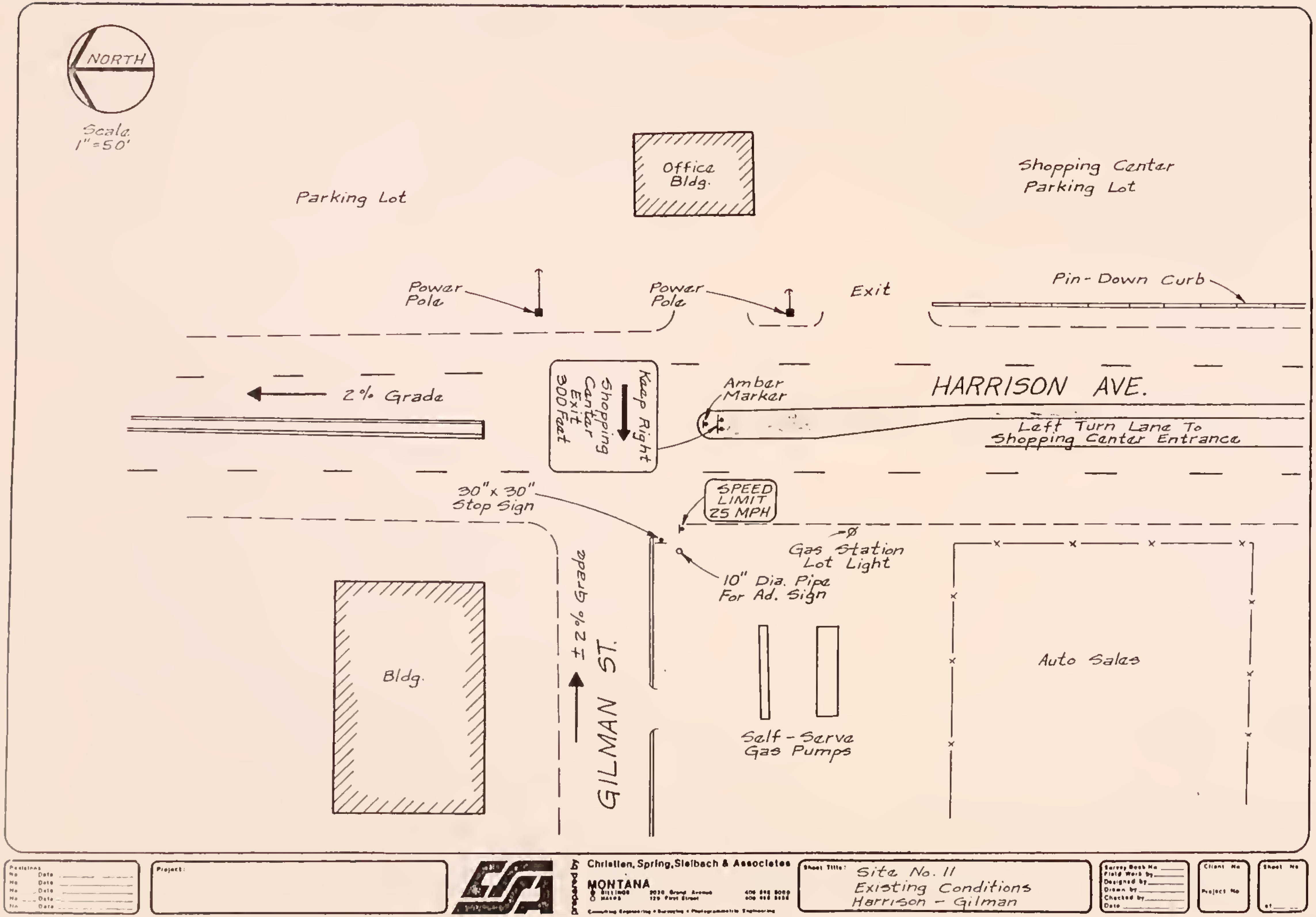
Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	3.6 acc/yr	45	x	0.145	=	6.53
Accident Rate	.61 acc/MEV	16	x	0.199	=	3.18
Accident Severity	5,340 dollars	50	x	0.169	=	8.45
Volume/Capacity Ratio	.17	35	x	0.073	=	2.56
Sight Distance Ratio	.55 (wt.avg.)	73	x	0.066	=	4.82
Driver Expectancy	3.7 (wt.avg.)	62	x	0.132	=	8.18
Info. System Deficiencies	3.3 (wt.avg.)	55	x	0.102	=	5.61
		SUMS:		0.886*		39.33

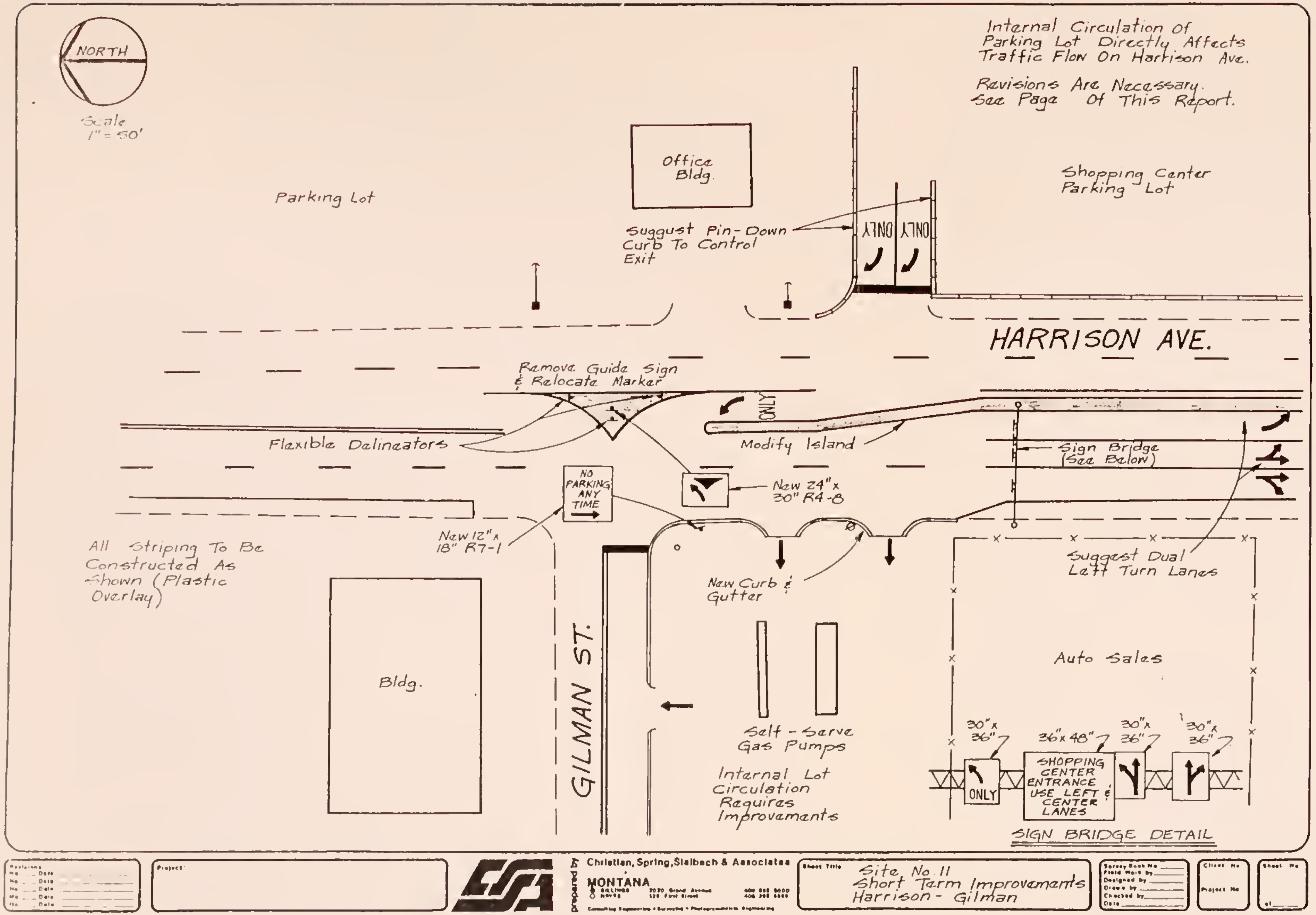
$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{39.33}{0.886} = 44.39$$

* The "Erratic Maneuvers" and "Traffic Conflict" indices were omitted from this study. Therefore the weight factors do not total 1.00 and all sites will be ranked on an 88.6% strength of evaluation relative to the FHWA Method.



SITE NO. 11 - HARRISON - GILMAN


NORTH
Scale
1"=50'
Parking Lot
Office
Bldg.
Shopping Center
Parking Lot
Power
Pole
Power
Pole
Exit
Pin-Down Curb
2% Grade
Keep Right
Shopping
Center
Exit
300 Feet
Amber
Marker
HARRISON AVE.
Left Turn Lane To
Shopping Center Entrance
30"x 30"
Stop Sign
SPEED
LIMIT
25 MPH
Gas Station
Lot Light
10" Dia. Pipe
For Ad. Sign
Bldg.
2% Grade
GILMAN ST.
Auto Sales
Self-Serve
Gas Pumps
Revisions
No Date
No Date
No Date
No Date
No Date
Project:
Christian, Spring, Sielbach & Associates
MONTANA
Sheet Title:
Site No. 11
Existing Conditions
Harrison - Gilman
Survey Book No
Field Work by
Designed by
Drawn by
Checked by
Date
Client No
Project No
Sheet No
of


NORTH
Scale 1" = 50'
Internal Circulation Of Parking Lot Directly Affects Traffic Flow On Harrison Ave.
Revisions Are Necessary. See Page Of This Report.
Office Bldg.
Parking Lot
Shopping Center Parking Lot
Suggest Pin-Down Curb To Control Exit
ONLY
ONLY
HARRISON AVE.
Remove Guide Sign & Relocate Marker
ONLY
Flexible Delineators
Modify Island
Sign Bridge (See Below)
NO PARKING ANY TIME
New 24" x 30" R4-8
New 12" x 18" R7-1
All Striping To Be Constructed As Shown (Plastic Overlay)
New Curb & Gutter
Suggest Dual Left Turn Lanes
Bldg.
GILMAN ST.
Auto Sales
Self-Serve Gas Pumps
Internal Lot Circulation Requires Improvements
30" x 36"
36" x 48"
30" x 36"
30" x 36"
ONLY
SHOPPING CENTER ENTRANCE USE LEFT & CENTER LANES
SIGN BRIDGE DETAIL
Christian, Spring, Sielbach & Associates
MONTANA
Site No. 11
Short Term Improvements
Harrison - Gilman

SITE

12

SITE NUMBER 12

WASHINGTON STREET - GRANITE STREET

LOCATION DESCRIPTION

The intersection of Washington and Granite is located just west of the Central Business District of Butte and is the intersection of two local streets.

EXISTING CONDITIONS

Geometrics. The Existing Condition Sketch details the horizontal alignment conditions of the intersection and the surrounding topographic features. Approach grades on Washington are extreme (approximately 12 percent) and the approach grades on Granite are mild on the east leg and extreme on the west leg. The grade conditions present severe sight distance problems for several traffic movements at the intersection. Adjacent buildings at the corners also inhibit sight distance. In addition there are no existing parking restrictions at any of the corners.

Signing. The only existing signing is two 24"x24" stop signs at both Washington Street approaches.

Pavement Markings. The centerline striping on Granite Street is the only existing pavement marking at this intersection.

Traffic Volumes. The figure on the following page is a graphic summary of turning movement volumes taken during an afternoon period. In December, 1979 automatic machine counts were taken at this intersection and expansion to Average Daily Traffic (ADT) produced a north-south entering volume of 650 vehicles

GRAPHIC SUMMARY OF VEHICLE MOVEMENTS

Observer Kent Brewer Date Nov 15, 1979 Day Thursday

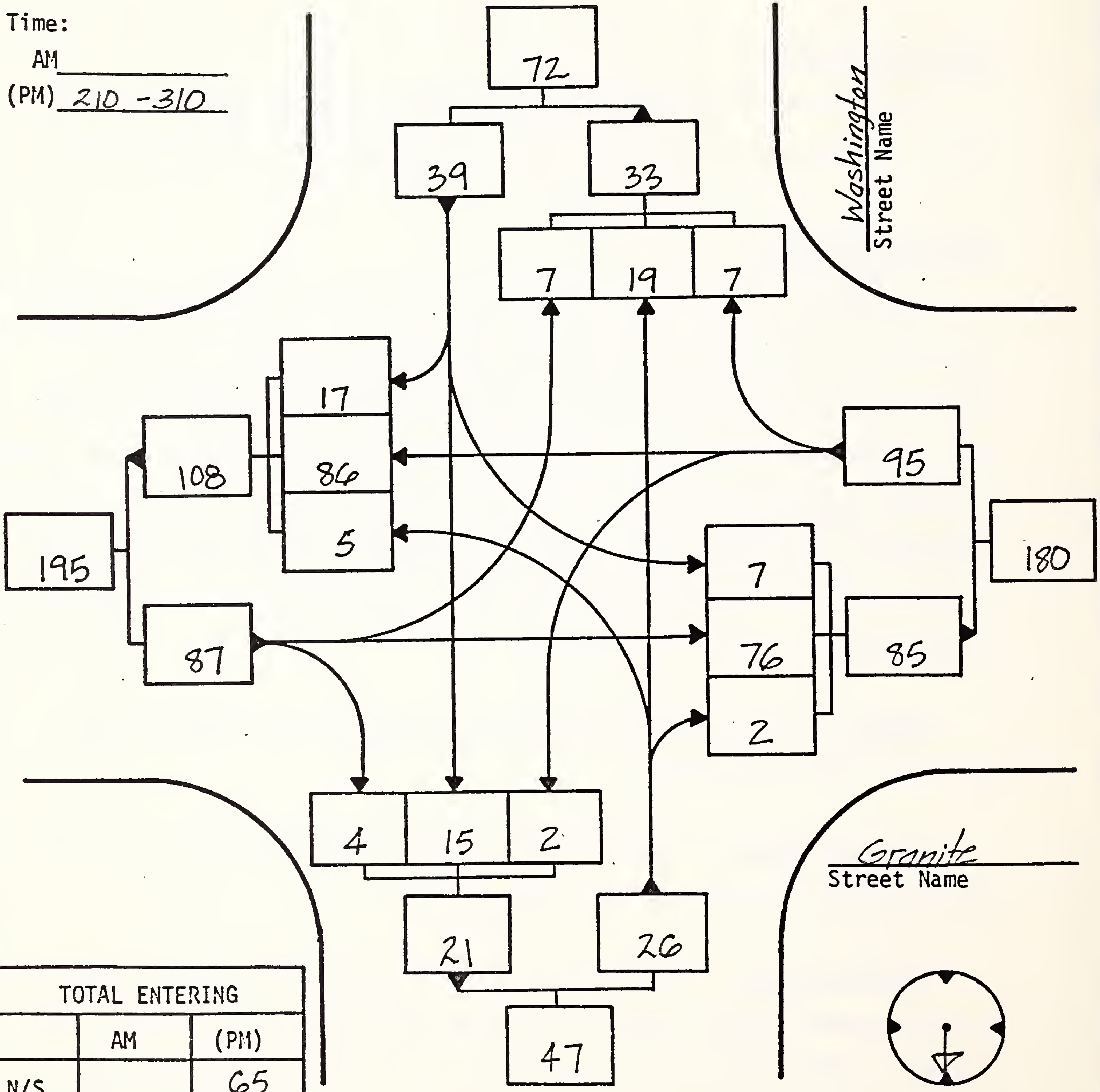
Intersection of Washington and Granite

City Butte Montana

Time:

AM ____________

(PM) 210 -310



TOTAL ENTERING

	AM	(PM)
N/S		65
E/W		182
Total		247

and an east-west approach entering volume of 1960. The Montana Department of Highways does not have special count stations near this location. Therefore, 1977 or 1978 counts are not available.

Traffic Operations. The intersection does not carry significant traffic volumes and therefore, as an intersection of two local streets, it appears to function fairly well. The extreme grade conditions present severe problems especially with icy street conditions or during dusk and dawn when the sun's position causes reduced visibility.

ACCIDENT ANALYSIS

In the two and one-half year period of accident reports, the intersection experienced 10 accidents. The Accident Summary Sheet provides a detailed breakdown of these accidents. The Summary Sheet indicates that the weather and road conditions were split equally among accidents reported, however most accidents occurred during the day and the predominant type of accident was the angle accident. Two left-turn accidents, one rear-end accident, and one accident involving a fixed object were reported. The number of angle and rear-end accidents seem to be consistent with the geometrics and traffic control conditions of this intersection.

SHORT TERM IMPROVEMENTS

The Short Term Improvement Sketch outlines the proposed pavement, striping and signing necessary to improve the safety and operation of this intersection. New 30"x30" stop signs should be located at the corners of the intersections controlling the stop situation on Washington Street. Pavement markings delineating lanes for driving and parking (including restrictions) should be completed. In addition a flasher signal with amber indications on Granite and red indications on Washington should be installed to increase driver expectancy.

LONG TERM IMPROVEMENTS

Since this intersection is in an area that has been established for many years and the system requirements cannot foreseeably change, no long term improvements at this location are recommended.

ECONOMIC BENEFIT

The anticipated accident reductions and related benefits derived from the recommended improvements are calculated below. The method of computation and forecasting accident reduction is detailed in the "Study Methodology" section of this report.

IMPROVEMENTS	ACCIDENTS		REDUCTION	
	Type	% of Total	% of Type	% of All Accidents
Short Term:	Angle	50	80	40
	Rear-End	10	20	2
	Left-Turn	20	30	6
	Total % Reduction of All Accidents			48

BENEFITS (Dollar Values)

(% Reduction) x (Accidents/Year) x (Useful Project Life) x (Average Severity)

Short Term: (0.48) x (3.6) x (20) x (4,310) = $148,950

PRELIMINARY COST ESTIMATE

Short Term Improvements

Item	Quantity	Unit	Unit Price	Cost
Pavement Marking (Painted)	15	Gal	$ 50.00	$ 750
Signs	2	Ea.	150.00	300
Flasher Signal (Complete)	1	L.S.	7000.00	7,000
		Total Short Term Improvements Cost		$8,050

COST BENEFIT RATIO

The cost benefit ratio is calculated below. The costs include replacement of striping once each year and the replacement of signing every 5 years. However, the costs do not include administration and engineering.

Cost \$/Benefit \$ = 23,200/148,950 = 0.1558

ACCIDENT SUMMARY

SITE NUMBER 12 LOCATION Washington-Granite REPORTING PERIOD November 21, 1979

NUMBERS OF ACCIDENTS

MONTH	NO.
JAN.	1
FEB.	
MARCH	3
APRIL	
MAY	1
JUNE	
JULY	
AUGUST	
SEPT.	1
OCT.	
NOV.	2
DEC.	1

DAY OF WK.	NO.
SUN.	1
MON.	2
TUES.	2
WED.	
THUR.	1
FRI.	1
SAT.	2

WEATHER	NO.
CLEAR	4
RAIN	1
SNOW	4
FOG	
OTHER	

ROAD CONDITION	NO.
DRY	4
WET	1
SNOWY	4
ICY	
OTHER	

LIGHT CONDITION	NO.
DAY	6
DAWN OR DUSK	1
DARK LIGHTED	2
DARK UN-LIGHTED	

ACCIDENT TYPE	NO.
ANGLE	5
LEFT TURN	2
REAR END	1
HEAD ON	
SIDE SWIPE	
PARKED VEHICLE	
BACKING	
FIXED OBJECT	1
PED.	
ANIMAL	

YEAR & SEVERITY	NO.
1977 FATAL	
INJURY	1
PROPERTY DAMAGE ONLY	4
1978 FATAL	
INJURY	1
PROPERTY DAMAGE ONLY	1
1979 FATAL	
INJURY	1
PROPERTY DAMAGE ONLY	1

HAZARD INDEX

BASIC COMPUTATIONS

Site Number 12 Date November 21, 1979

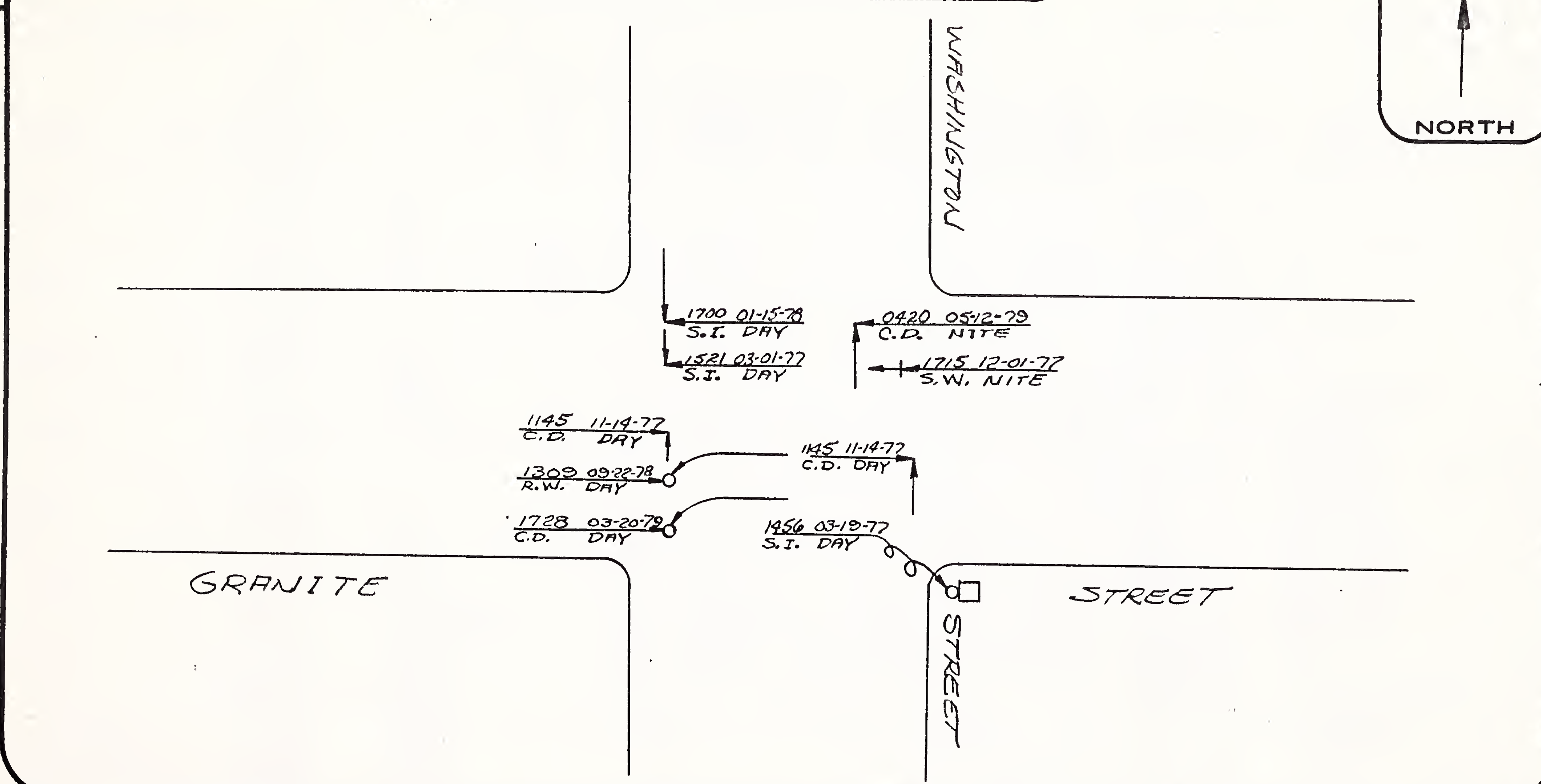
Description Washington - Granite

Indicator	Data Value	Indicator Value		Weight		Partial H.I.'s
Number of Accidents	3.6 acc/yr	45	x	0.145	=	6.53
Accident Rate	3.78 acc/MEV	67	x	0.199	=	13.33
Accident Severity	4,310 dollars	46	x	0.169	=	7.77
Volume/Capacity Ratio	0.04	16	x	0.073	=	1.17
Sight Distance Ratio	.32 (wt.avg.)	86	x	0.066	=	5.68
Driver Expectancy	4.5 (wt.avg.)	75	x	0.132	=	9.90
Info. System Deficiencies	3 (wt.avg.)	50	x	0.102	=	5.10
		SUMS:		0.886*		49.48

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{49.48}{0.886} = 55.85$$

* The "Erratic Maneuvers" and "Traffic Conflict" indices were omitted from this study. Therefore the weight factors do not total 1.00 and all sites will be ranked on an 88.6% strength of evaluation relative to the FHWA Method.

COLLISION DIAGRAM



SYMBOLS

VEHICLE PATH
PEDESTRIAN PATH
BACKING VEHICLE
PARKED VEHICLE
FIXED OBJECT
FATAL ACCIDENT
INJURY ACCIDENT

COLLISION TYPES

REAR END
HEAD ON
SIDE SWIPE
OUT OF CONTROL
LEFT TURN
ANGLE

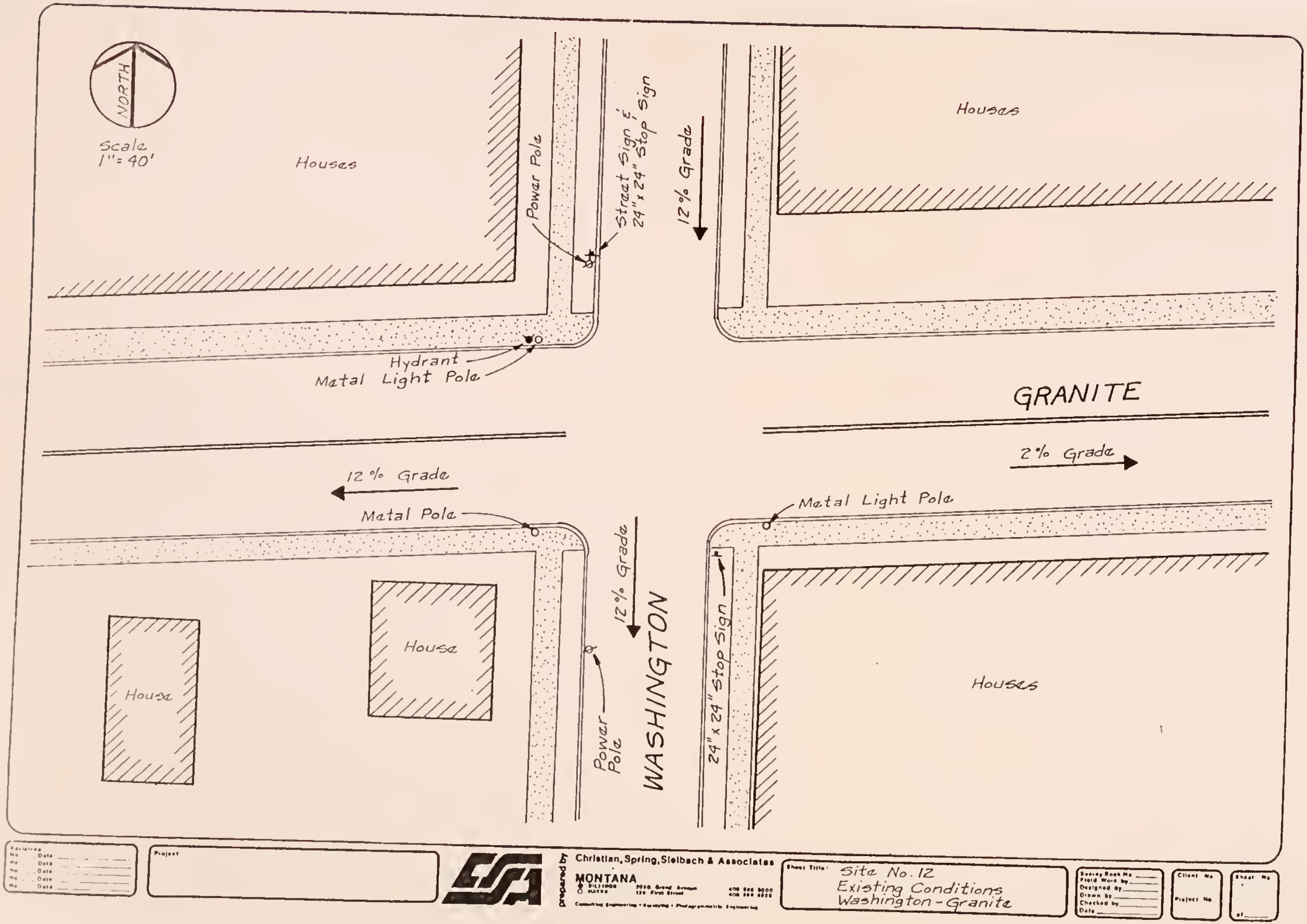
CONDITIONS

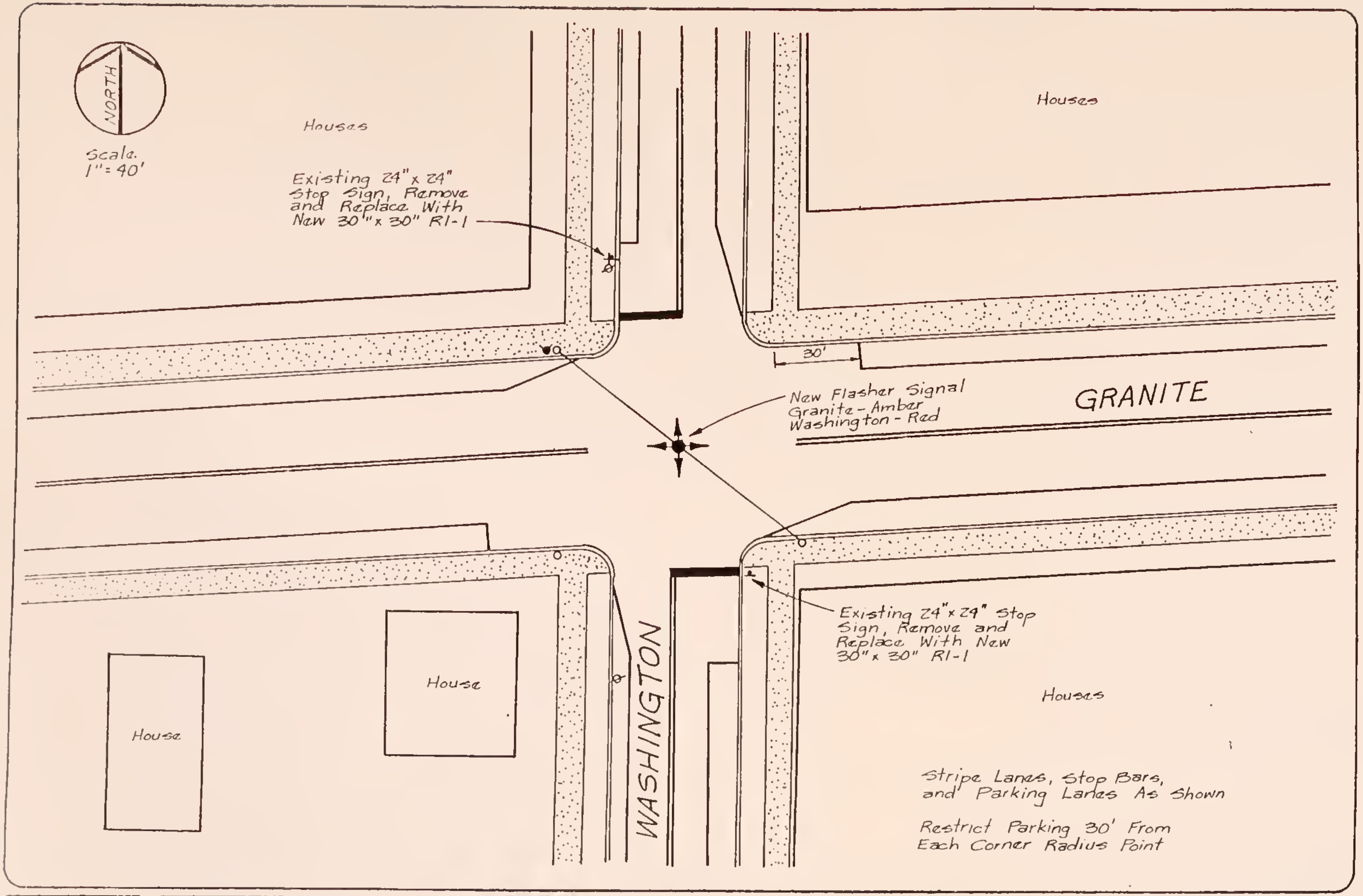
WEATHER: C=CLEAR, F=FOG, R=RAIN, S=SNOW, SL=SLEET

PAVEMENT: D=DRY, W=WET, I=ICY

TIME — 1400 7-05-75 — DATE
WEATHER — C.D. DAY — LIGHT
PAVEMENT

SITE NO. 12 - WASHINGTON - GRANITE


NORTH
Scale
1"=40'
Houses
Power Pole
Street Sign &
24"x24" Stop Sign
12% Grade
Houses
Hydrant
Metal Light Pole
GRANITE
2% Grade
12% Grade
Metal Pole
Metal Light Pole
12% Grade
House
House
Power Pole
WASHINGTON
24"x24" Stop Sign
Houses
Project
prepared by
Christian, Spring, Sielbach & Associates
MONTANA
Sheet Title:
Site No. 12
Existing Conditions
Washington - Granite
Drawn by
Checked by
Date
Client No
Project No
Sheet No
of



Revisions
No ___ Date ________
No ___ Date ________
No ___ Date ________
No ___ Date ________
No ___ Date ________

Project:

Prepared by
Christian, Spring, Sielbach & Associates
MONTANA
Consulting Engineering • Surveying • Photogrammetric Engineering

Sheet Title: Site No. 12
Short Term Improvements
Washington - Granite

Survey Book No. ____
Field Work by ____
Designed by ____
Drawn by ____
Checked by ____
Date ____

Client No.
Project No.

Sheet No.
of ____

SITE

13

SITE NUMBER 13

WYOMING AVENUE - GALENA STREET

LOCATION DESCRIPTION

The intersection of Wyoming and Galena is located within the limits of the central business district of Butte. Wyoming Street is a north-south local street and Galena is a principal arterial and is the west bound leg of a one-way couplet with Park Street.

EXISTING CONDITIONS

Geometrics. The Existing Condition Sketch details the intersection geometrics and surrounding topography. The approach grades on Galena Street are approximately 2% while the approach grades on Wyoming are the maximum desirable approach grades for an intersection (6%). A building in the south-west quadrant of the intersection is close to the curb line and provides the only permanent site distance restriction at the intersection. In the north-west quadrant an advertising sign and numerous parked vehicles provide a severe sight restriction for southbound approach vehicles.

Signing. The only signs presently existing that are pertinent to the operation of the intersection are stop signs on Wyoming, one-way signs located on the same pole as the stop sign at the southeast quadrant of the intersection and parking restriction signs. An advertising sign does block the view of the stop sign in the northwest quadrant of the intersection.

Pavement Markings. The existing pavement markings are standard in application, however they are deficient in extent. Crosswalk striping is not provided across Wyoming Street where sufficient pedestrian traffic would warrant their inclusion.

Traffic Volumes. The figure on the following page is a graphic summary of evening peak hour turning movement counts. It should be noted that the traffic volumes on Wyoming are significantly greater than those on the westbound Galena approach. The heaviest turn movement is the north approach right-turn onto Galena, which is approximately 60% of all approach traffic. The average daily traffic expansion of this peak hour count produces an ADT of 2400 for north-south approach traffic and 1470 for westbound approach traffic. The Montana Department of Highways counts on Wyoming Street near the intersection produced an average ADT of 2270 in 1977-1978, which correlates with the ADT expansion. December 1979 machine counts verified the expansion figure.

Traffic Operations. Relatively larger traffic volumes on Wyoming in combination with the heavy right-turn movement onto Galena creates a situation that does not seem consistent with the right-of-way control measures that exist. Vehicles approaching the intersection on Wyoming must pull beyond the stop bars to gain adequate sight distance to cross Galena. The Galena crossing is wide and has three lanes of opposing traffic. The number of lanes provided on Galena reduces the gap availability for cross traffic on Wyoming.

GRAPHIC SUMMARY OF VEHICLE MOVEMENTS

Observer Kent Brewer Date Nov ~~14~~, 1979 Day Wednesday

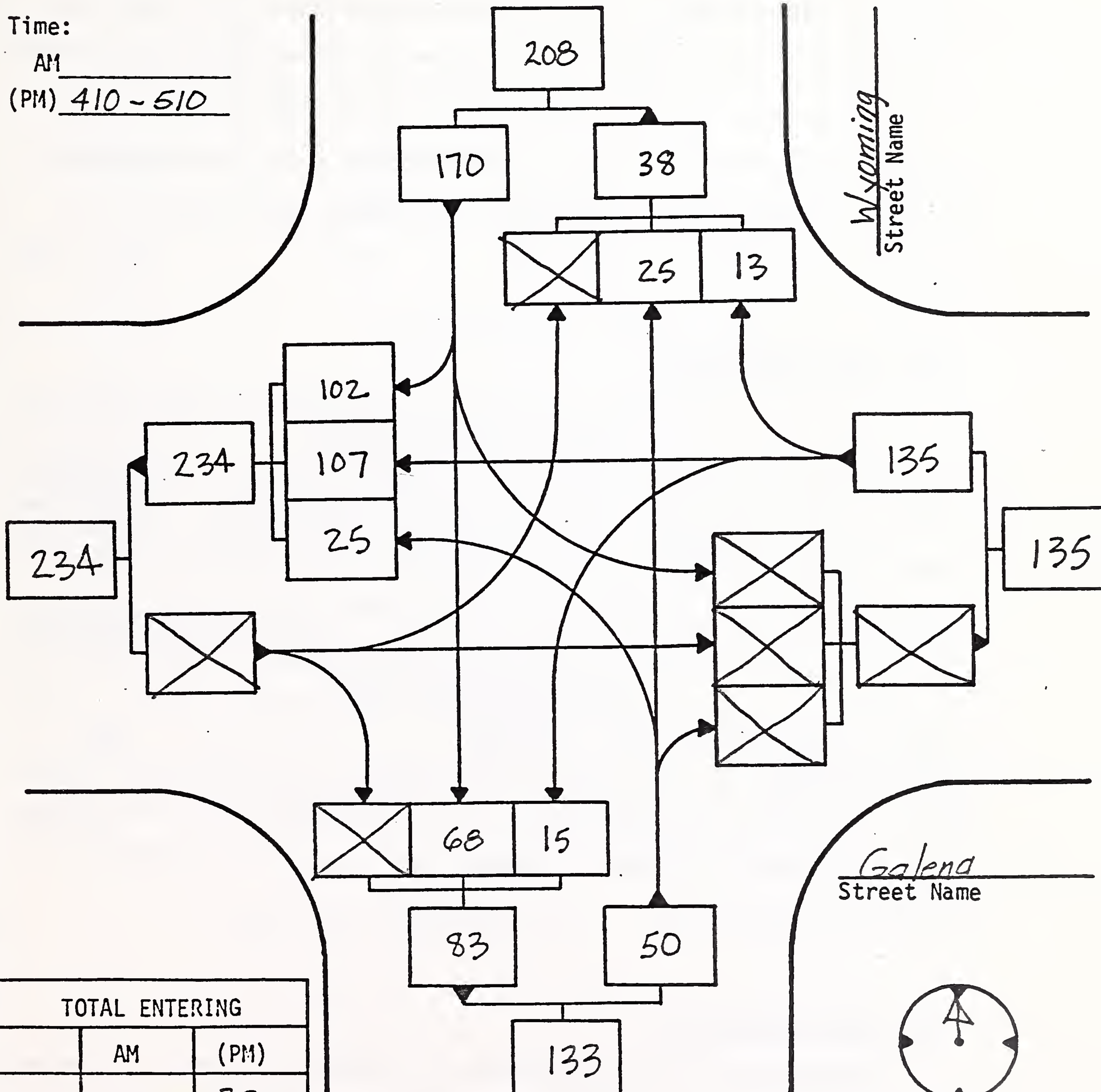
Intersection of Wyoming and Galena

City Butte Montana

Time:

AM ______

(PM) 410 - 510



Indicate North

TOTAL ENTERING		
	AM	(PM)
N/S		220
E/W		135
Total		375

CSSA Traffic Form 104

ACCIDENT ANALYSIS

In the two and one-half year period from 1977 through June of 1979 there were 10 reported accidents. The Accident Summary Sheet presents a detailed breakdown of the accident types and conditions. From this sheet it can be seen that the majority of accidents occurred during clear weather, on dry roads and in daylight hours. There were 8 angle accidents. The remaining two accidents involved a parked vehicle and a backing manuever. The large number of angle accidents is not unusual considering existing intersection control and geometrics.

SHORT TERM IMPROVEMENTS

Due to the traffic volume distribution and geometrics contributing to the angle accidents, it is recommended that the intersection be modified to provide a three-way stop. The Short Term Improvement Sketch indicates the addition of two stop signs on Galena Street and the appropriate three-way supplementary plates on the remaining stop signs. The pavement markings should be striped as shown on the Short Term Improvement Sketch which will aid in defining lane and parking designations. The northwest quadrant of the intersection has no curb control at the corner, which allows parking and other maneuvers across the corner. It is recommended that a new concrete curb and gutter section be contructed to aid in channelizing traffic and in controlling parking.

LONG TERM IMPROVEMENTS

The operation of this intersection in the future is heavily dependent upon system changes in the CBD. Long Term Improvements cannot be recommended within the limits of this study.

ECONOMIC BENEFIT

The anticipated accident reductions and related benefits derived from the recommended improvements are calculated below. The method of computation and forecasting accident reduction is detailed in the "Study Methodology" section of this report.

IMPROVEMENTS	ACCIDENTS		REDUCTION	
	Type	% of Total	% of Type	% of All Accidents
Short Term:	Angle	80	80	64
		Total % Reduction of All Accidents		64

BENEFITS (Dollar Values)

(% Reduction) x (Accidents/Year) x (Useful Project Life) x (Average Severity)

Short Term: (0.64) x (4.0) x (5) x (3,760) = $ 48,130

PRELIMINARY COST ESTIMATE

Short Term Improvements

Item	Quantity	Unit	Unit Price	Cost
Pavement Marking (Plastic Overlay)	1250	L.F.	$ 1.75	$ 2,180
Signing	6	Each	120.00	720
Curb and Gutter	135	L.F.	10.00	1,350
Short Term Improvements Cost				$ 4,250

COST BENEFIT RATIO

The cost-benefit ratio is calculated below. Not included in the cost is replacement or maintenance over the 5 year life. Also, the intial cost of administration and engineering is not included.

$$\text{Cost \$/Benefit \$} = 4{,}250/48{,}130 = \underline{0.0883}$$

ACCIDENT SUMMARY

SITE NUMBER 13 LOCATION Wyoming - Galena REPORTING PERIOD November 21, 1979

NUMBERS OF ACCIDENTS

MONTH	NO.
JAN.	
FEB.	
MARCH	1
APRIL	3
MAY	
JUNE	
JULY	2
AUGUST	
SEPT.	2
OCT.	1
NOV.	1
DEC.	

DAY OF WK.	NO.
SUN.	1
MON.	3
TUES.	2
WED.	
THUR.	4
FRI.	
SAT.	

WEATHER	NO.
CLEAR	7
RAIN	2
SNOW	1
FOG	
OTHER	

ROAD CONDITION	NO.
DRY	6
WET	3
SNOWY	
ICY	1
OTHER	

LIGHT CONDITION	NO.
DAY	10
DAWN OR DUSK	
DARK LIGHTED	
DARK UN-LIGHTED	

ACCIDENT TYPE	NO.
ANGLE	8
LEFT TURN	
REAR END	
HEAD ON	
SIDE SWIPE	
PARKED VEHICLE	1
BACKING	1
FIXED OBJECT	
PED.	
ANIMAL	

YEAR & SEVERITY	NO.
1977 FATAL	
INJURY	
PROPERTY DAMAGE ONLY	5
1978 FATAL	
INJURY	
PROPERTY DAMAGE ONLY	2
1979 FATAL	
INJURY	
PROPERTY DAMAGE ONLY	3

HAZARD INDEX

BASIC COMPUTATIONS

Site Number 13 Date November 21, 1979

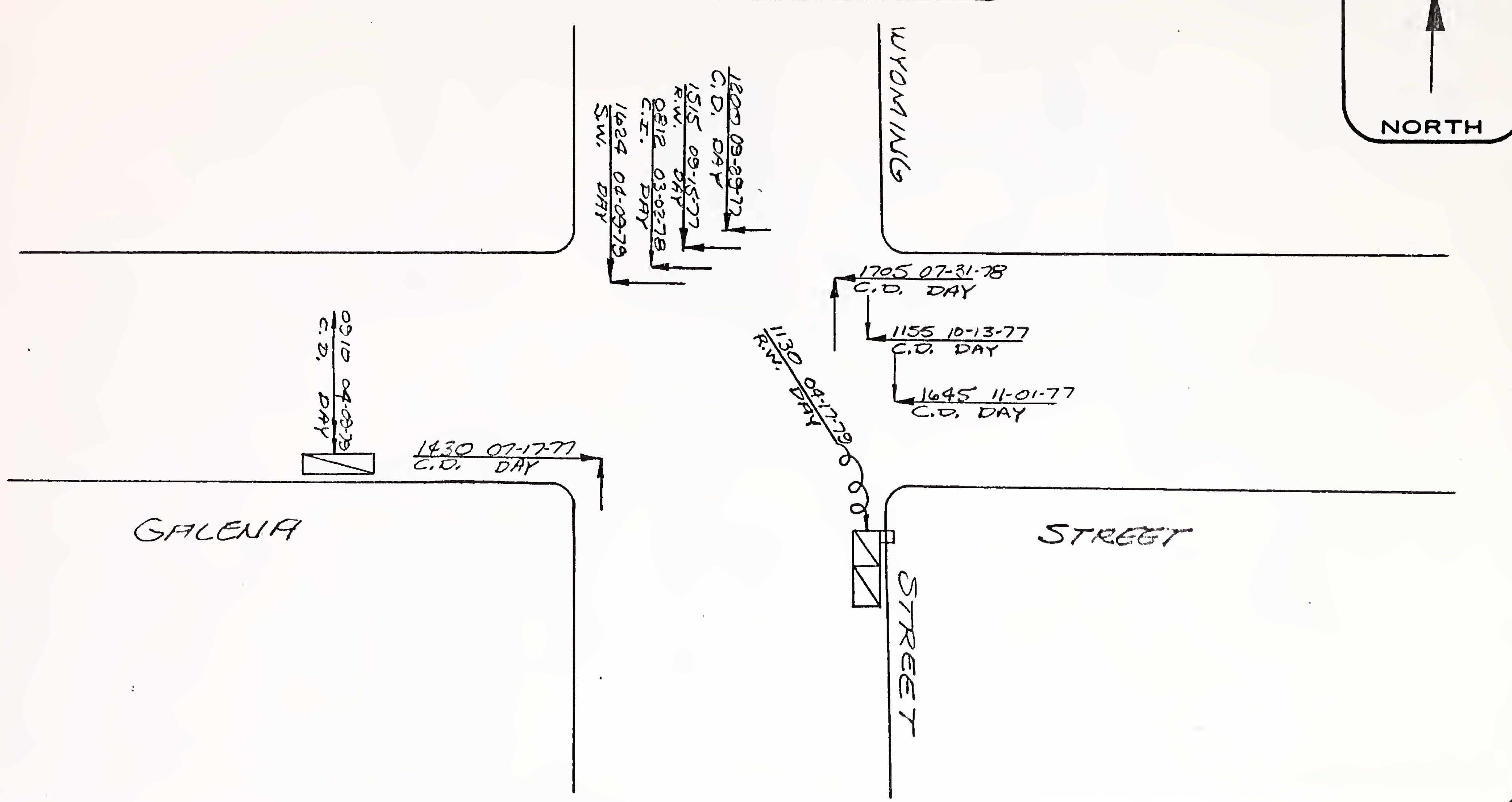
Description Wyoming-Galena

Indicator	Data Value		Indicator Value		Weight		Partial H.I.'s
Number of Accidents	4.0	acc/yr	46	x	0.145	=	6.67
Accident Rate	2.99	acc/MEV	56	x	0.199	=	11.14
Accident Severity	3,760	dollars	42	x	0.169	=	7.10
Volume/Capacity Ratio	0.05		19	x	0.073	=	1.39
Sight Distance Ratio	.40	(wt.avg.)	82	x	0.066	=	5.41
Driver Expectancy	3.7	(wt.avg.)	62	x	0.132	=	8.18
Info. System Deficiencies	3.3	(wt.avg.)	55	x	0.102	=	5.61
			SUMS:		0.886*		45.50

$$\text{H.I.} = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{45.50}{0.886} = 51.35$$

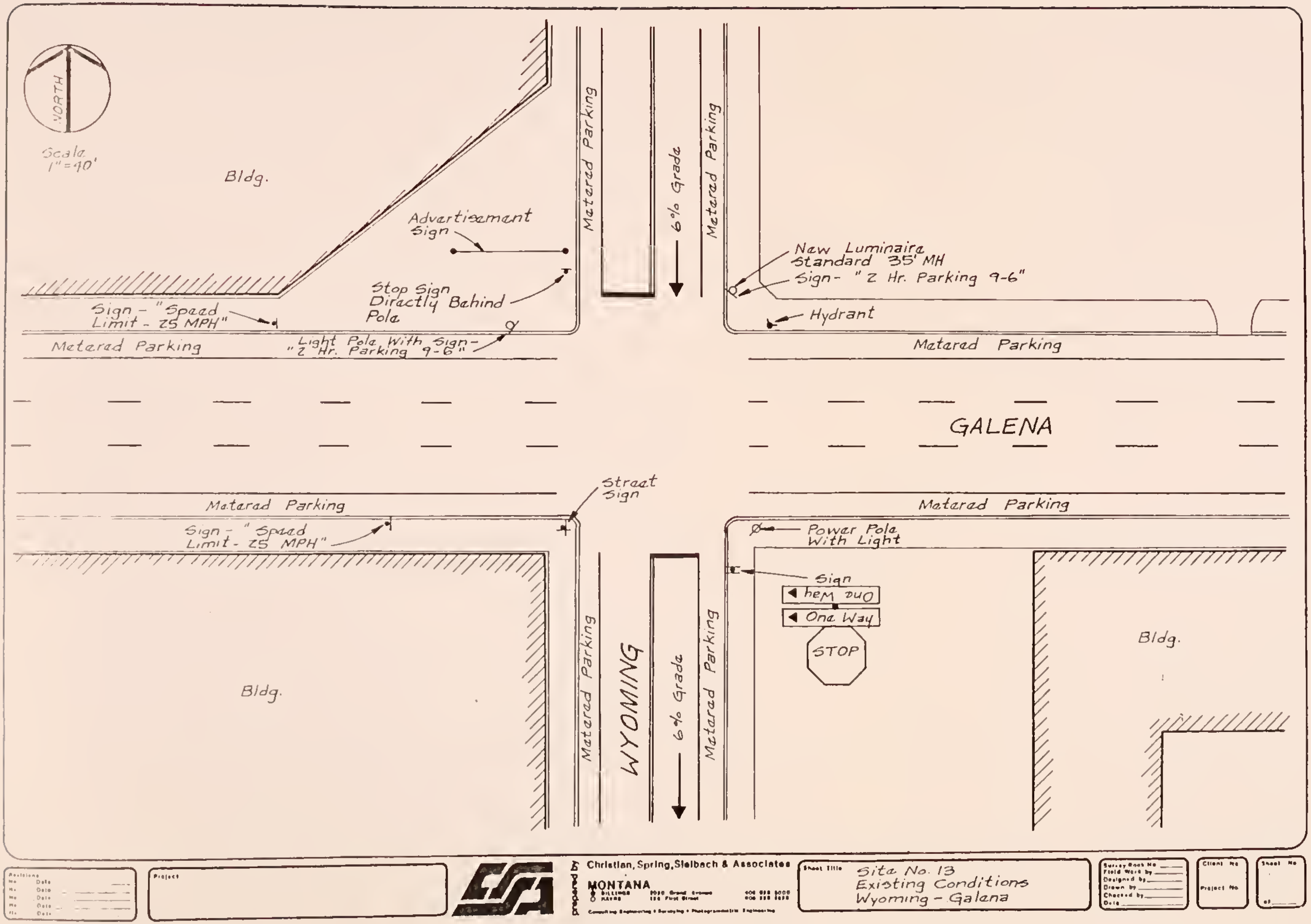
* The "Erratic Maneuvers" and "Traffic Conflict" indices were omitted from this study. Therefore the weight factors do not total 1.00 and all sites will be ranked on an 88.6% strength of evaluation relative to the FHWA Method.

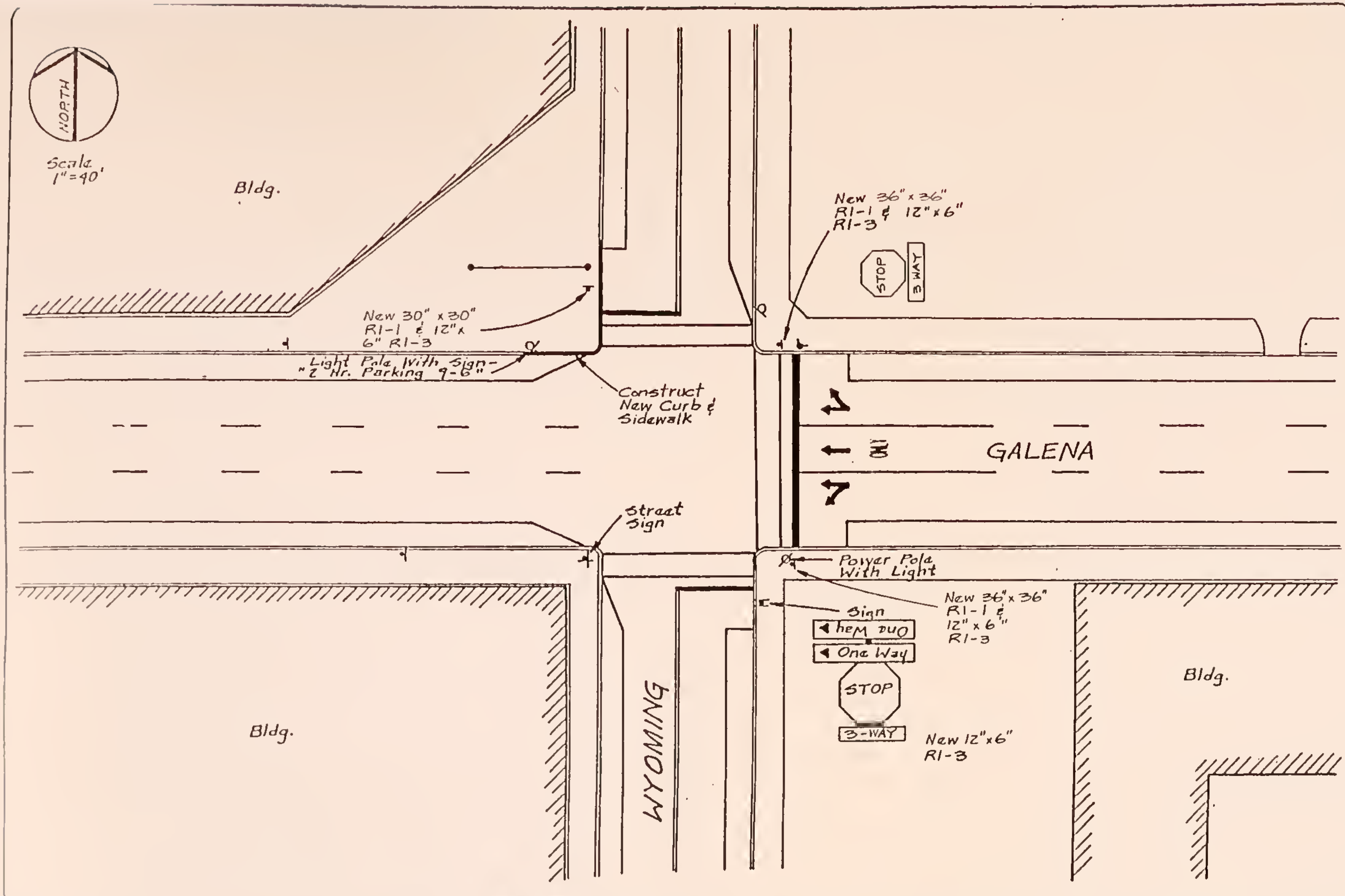
COLLISION DIAGRAM



SYMBOLS	COLLISION TYPES	CONDITIONS
VEHICLE PATH	REAR END	WEATHER: C=CLEAR, F=FOG, R=RAIN, S=SNOW, SL=SLEET
PEDESTRIAN PATH	HEAD ON	PAVEMENT: D=DRY, W=WET, I=ICY
BACKING VEHICLE	SIDE SWIPE	TIME — 1400
PARKED VEHICLE	OUT OF CONTROL	DATE — 7-05-75
FIXED OBJECT	LEFT TURN	WEATHER — C.D. — PAVEMENT
FATAL ACCIDENT	ANGLE	LIGHT — DAY
INJURY ACCIDENT		

SITE NO. 13 - WYOMING - GALENA


NORTH
Scale 1" = 40'
Bldg.
Advertisement Sign
Stop Sign Directly Behind Pole
Sign - "Speed Limit - 25 MPH"
Light Pole With Sign - "2 Hr. Parking 9-6"
Metered Parking
6% Grade
New Luminaire Standard 35' MH
Sign - "2 Hr. Parking 9-6"
Hydrant
GALENA
Street Sign
Power Pole With Light
Sign
One Way
One Way
STOP
WYOMING
prepared by
Christian, Spring, Sielbach & Associates
MONTANA
Sheet Title
Site No. 13
Existing Conditions
Wyoming - Galena



Christian, Spring, Sielbach & Associates
MONTANA

Sheet Title: Site No. 13
Short Term Improvements
Wyoming - Galena

SITE

14

SITE NUMBER 14

HARRISON AVENUE - 'A' STREET

LOCATION DESCRIPTION

Intersections of Harrison Avenue and 'A' Street is located in the fringe business district of Butte. Harrison Avenue is a principal north-south arterial and 'A' Street is a local street with its eastern most terminus at Harrison Avenue.

EXISTING CONDITIONS

Geometrics. The Existing Condition Sketch indicates that the intersection of Harrison Avenue and 'A' Street is a "T" intersection. There is a slight curvature in Harrison Avenue at the point of intersection with a delta of approximately 10 degrees. 'A' Street curves to intersect Harrison Avenue at a 90 degree angle approximately 120 feet west of Harrison. The curvature of 'A' Street has an approximate delta of 30 to 35 degress. Two buildings surround the approach of 'A' Street to Harrison. An advertising sign for the commercial building in the northwest quadrant of the intersection restricts sight distance as does existing parking conditions in front of both buildings. There are curb and gutter sections along most of the east half of Harrison Avenue and intermittent curb on the west half. Commercial establishments and paved parking lots west, south and west of Harrison are not segregated from the street by any type of curb or lined section, thus presenting an unrestricted approach.

Signing. The only existing signing pertaining to the intersection is a stop sign for the 'A' Street approach.

Pavement Markings. The existing pavement markings are standard and limited by the extent to which they were applied.

Traffic Volumes. The figure on the following page presents a graphic summary of morning and peak evening turning movement counts taken at this location. An Average Daily Traffic (ADT) expansion of these turning movement counts produced a Harrison Avenue north-south entering approach volume of 16,190 and an 'A' Street eastbound approach volume of 890 vehicles. The 1979 machine counts at this intersection correlates with the morning and evening expansion figures.

Traffic Operations. The traffic on 'A' Street is almost insignificant compared to the volume of traffic on Harrison Avenue. This condition contributes to unexpected maneuvers on the approach from Harrison to 'A' Street. The approach from 'A' Street to Harrison is hazardous due to the geometrics and parking conditions found at this intersection.

ACCIDENT ANALYSIS

In the two and one-half year reporting period from 1977 to June of 1979 there were a total of ten accidents at this site. The Summary Sheet indicates that the majority of accidents occurred in clear weather on dry roads and mainly during the daylight hours. The predominant type was rear-end accidents, with left-turn and side-swipe accidents being the second and third most common types respectively. As in the Harrison - Ottawa accident site, the rear-end type accident is unusual at an unsignalized intersection and can be attributed to the low volume of traffic and resulting low driver expectancy.

GRAPHIC SUMMARY OF VEHICLE MOVEMENTS

Observer K. Behling - K. Brewer Date Nov. 15, 1979 Day Thursday

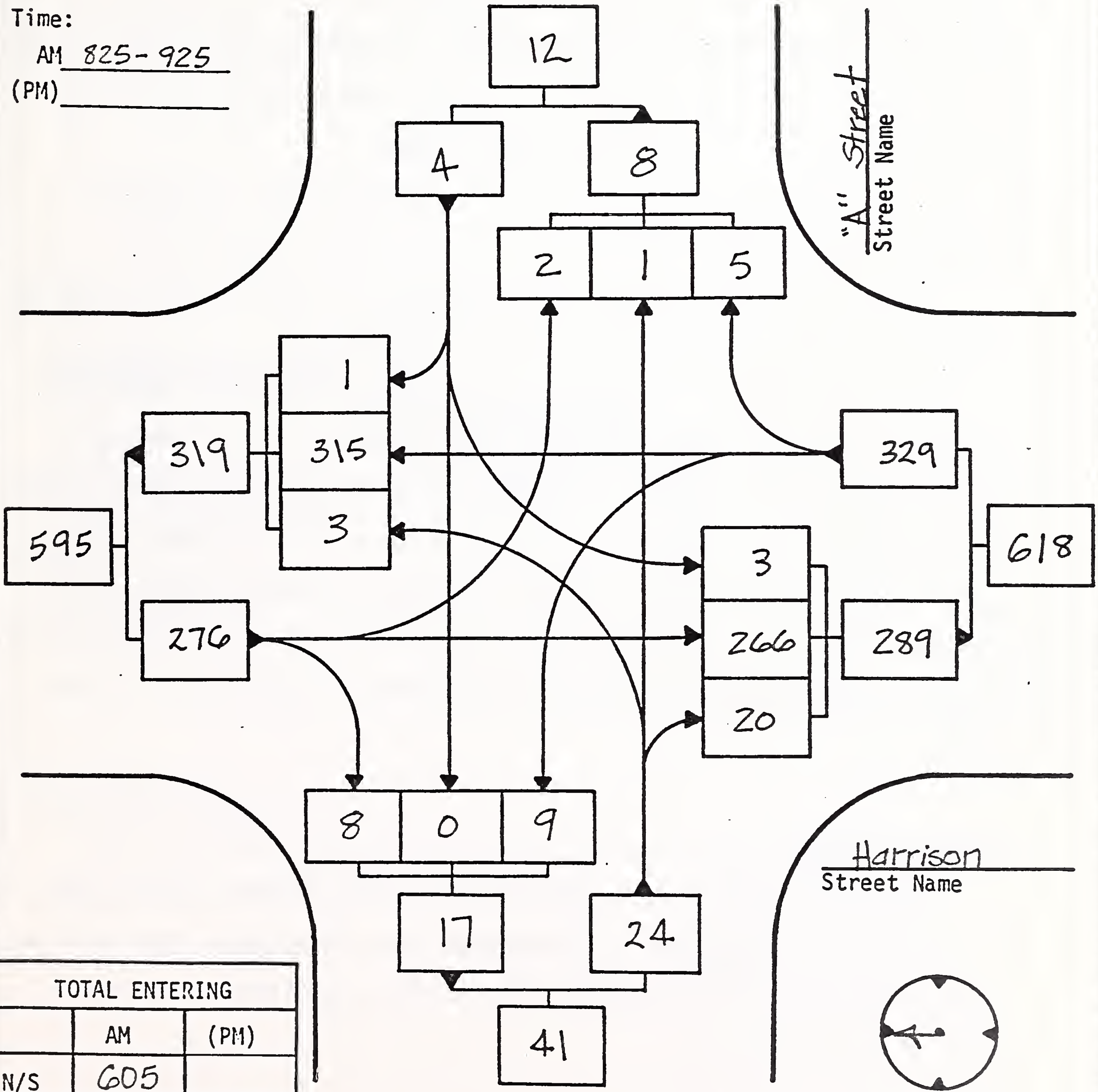
Intersection of Harrison and "A" Street

City Butte Montana

Time:

AM 825-925

(PM)



TOTAL ENTERING		
	AM	(PM)
N/S	605	
E/W	28	
Total	633	

SHORT TERM IMPROVEMENTS

The Short Term Improvement Sketch details the recommended improvements to alleviate traffic conflicts and increase efficiency at this intersection. It is recommended that new curb and gutter sections be installed around the approach and radii to 'A' Street and that parking be eliminated at least 30 feet on each side and in front of the buildings to increase sight distance for 'A' Street approach traffic.

LONG TERM IMPROVEMENTS

Long term improvements cannot be recommended at this particular location without including a large section of Harrison Avenue.

Due to the numerous businesses fronting Harrison Avenue and the large amount of approach volume generated by these businesses, it is recommended that Harrison Avenue change its operation from four driving lanes to a section providing four lanes with a continuous left-turn lane. This change should extend from Yale Avenue on the southern extremity to George Street on the northern extremity of Harrison Avenue. Due to the limitations in scope of this report, prioritizing of this long term improvement is not practical at this time.

ECONOMIC BENEFIT

The anticipated accident reductions and related benefits derived from the recommended improvements are calculated below. The method of computation and forecasting accident reduction is detailed in the "Study Methodology" section of this report.

IMPROVEMENTS	ACCIDENTS		REDUCTION	
	Type	% of Total	% of Type	% of All Accidents
Short Term:	Rear-End	50	50	25
	Left-Turn	30	10	3
	Side-Swipe	20	50	10
	Total % Reduction of All Accidents			38

BENEFITS (Dollar Values)

(% Reduction) x (Accidents/Year) x (Useful Project Life) x (Average Severity)

Short Term: (0.38) x (4.0) x (5) x (3,850) = $29,260

PRELIMINARY COST ESTIMATE

Short Term Improvements

Item	Quantity	Unit	Unit Price	Cost
Pavement Markings (Paint)	5	Gal	$ 50.00	$ 250
Signs	2	Ea.	120.00	240
Curb and Gutter	410	L.F.	10.00	4,100
Total Short Term Improvements Cost				$4,590

COST BENEFIT RATIO

The cost benefit ratio is calculated below. The cost of replacing pavement markings twice a year during the 5-year life of the project in included.

Cost $/Benefit $ = 6,840/29,260 = 0.2338

ACCIDENT SUMMARY

SITE NUMBER 14 LOCATION Harrison-"A" Street REPORTING PERIOD November 21, 1979

NUMBERS OF ACCIDENTS

MONTH	NO.
JAN.	1
FEB.	
MARCH	2
APRIL	
MAY	
JUNE	2
JULY	1
AUGUST	
SEPT.	2
OCT.	1
NOV.	1
DEC.	

DAY OF WK.	NO.
SUN.	
MON.	1
TUES.	2
WED.	
THUR.	2
FRI.	4
SAT.	1

WEATHER	NO.
CLEAR	8
RAIN	1
SNOW	1
FOG	
OTHER	

ROAD CONDITION	NO.
DRY	7
WET	1
SNOWY	2
ICY	
OTHER	

LIGHT CONDITION	NO.
DAY	6
DAWN OR DUSK	
DARK LIGHTED	4
DARK UN-LIGHTED	

ACCIDENT TYPE	NO.
ANGLE	
LEFT TURN	3
REAR END	5
HEAD ON	
SIDE SWIPE	2
PARKED VEHICLE	
BACKING	
FIXED OBJECT	
PED.	
ANIMAL	

YEAR & SEVERITY	NO.
1977 FATAL	
INJURY	
PROPERTY DAMAGE ONLY	4
1978 FATAL	
INJURY	1
PROPERTY DAMAGE ONLY	4
1979 FATAL	
INJURY	
PROPERTY DAMAGE ONLY	1

HAZARD INDEX

BASIC COMPUTATIONS

Site Number 14 Date November 21, 1979

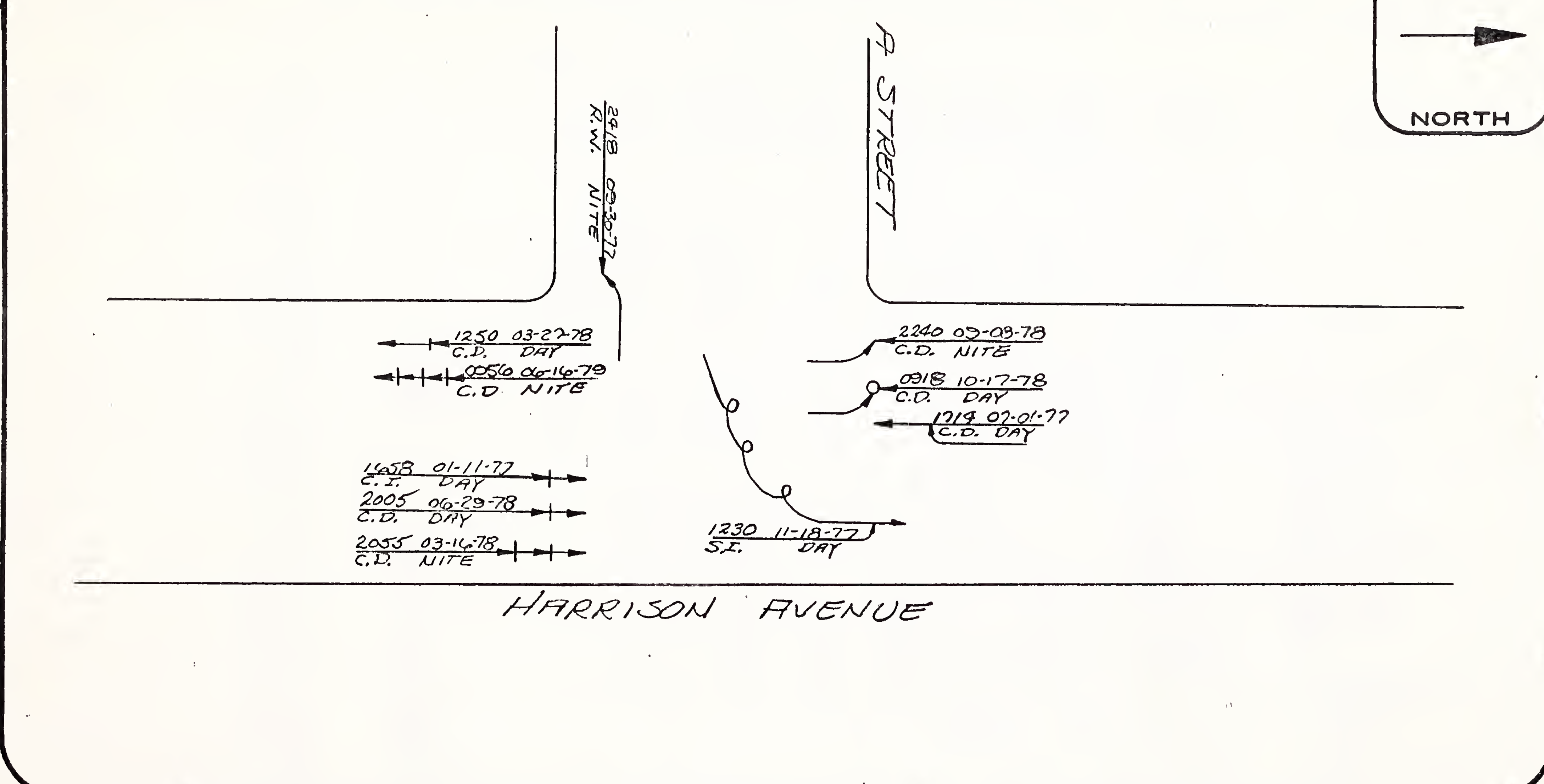
Description Harrison - 'A' Street

Indicator	Data Value		Indicator Value		Weight		Partial H.I.'s
Number of Accidents	4.0	acc/yr	46	x	0.145	=	6.67
Accident Rate	0.71	acc/MEV	18	x	0.199	=	3.58
Accident Severity	3,850	dollars	44	x	0.169	=	7.44
Volume/Capacity Ratio	0.22		40	x	0.073	=	2.92
Sight Distance Ratio	0.37	(wt.avg.)	83	x	0.066	=	5.48
Driver Expectancy	3.7	(wt.avg.)	62	x	0.132	=	8.18
Info. System Deficiencies	2.7	(wt.avg.)	45	x	0.102	=	4.59
			SUMS:		0.886*		38.86

$$\text{H.I.} = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{38.86}{0.886} = 43.86$$

* The "Erratic Maneuvers" and "Traffic Conflict" indices were omitted from this study. Therefore the weight factors do not total 1.00 and all sites will be ranked on an 88.6% strength of evaluation relative to the FHWA Method.

COLLISION DIAGRAM



SYMBOLS

VEHICLE PATH
PEDESTRIAN PATH
BACKING VEHICLE
PARKED VEHICLE
FIXED OBJECT
FATAL ACCIDENT
INJURY ACCIDENT

COLLISION TYPES

REAR END
HEAD ON
SIDE SWIPE
OUT OF CONTROL
LEFT TURN
ANGLE

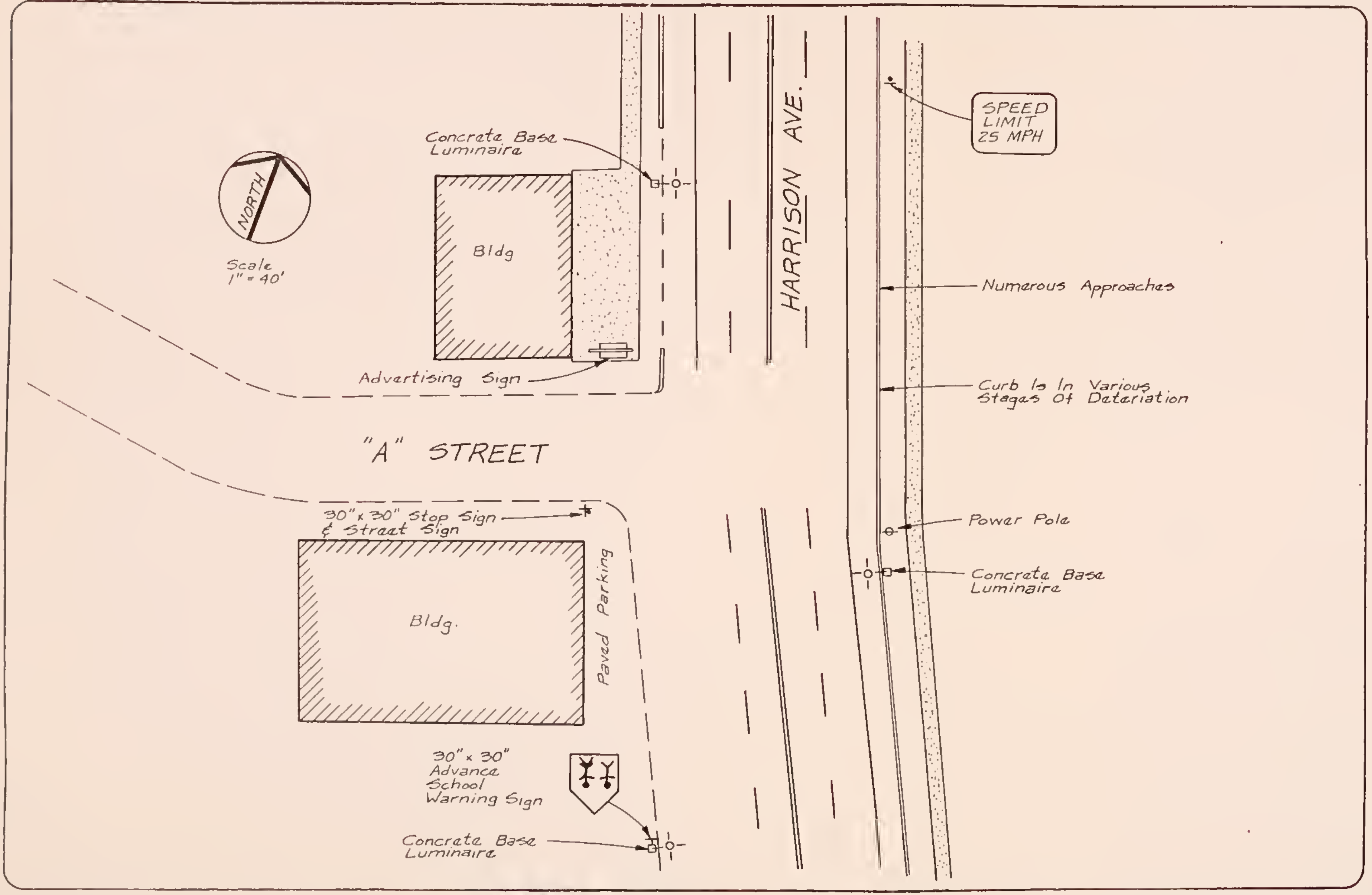
CONDITIONS

WEATHER: C=CLEAR, F=FOG, R=RAIN, S=SNOW, SL=SLEET

PAVEMENT: D=DRY, W=WET, I=ICY

TIME — 1400
DATE — 7-05-75
WEATHER — C.D.
PAVEMENT
LIGHT — DAY

SITE NO. 14 - HARRISON - 'A' STREET



Revisions

Project

prepared by
Christian, Spring, Sielbach & Associates
MONTANA

Sheet Title
Site No. 14
Existing Conditions
Harrison - "A"

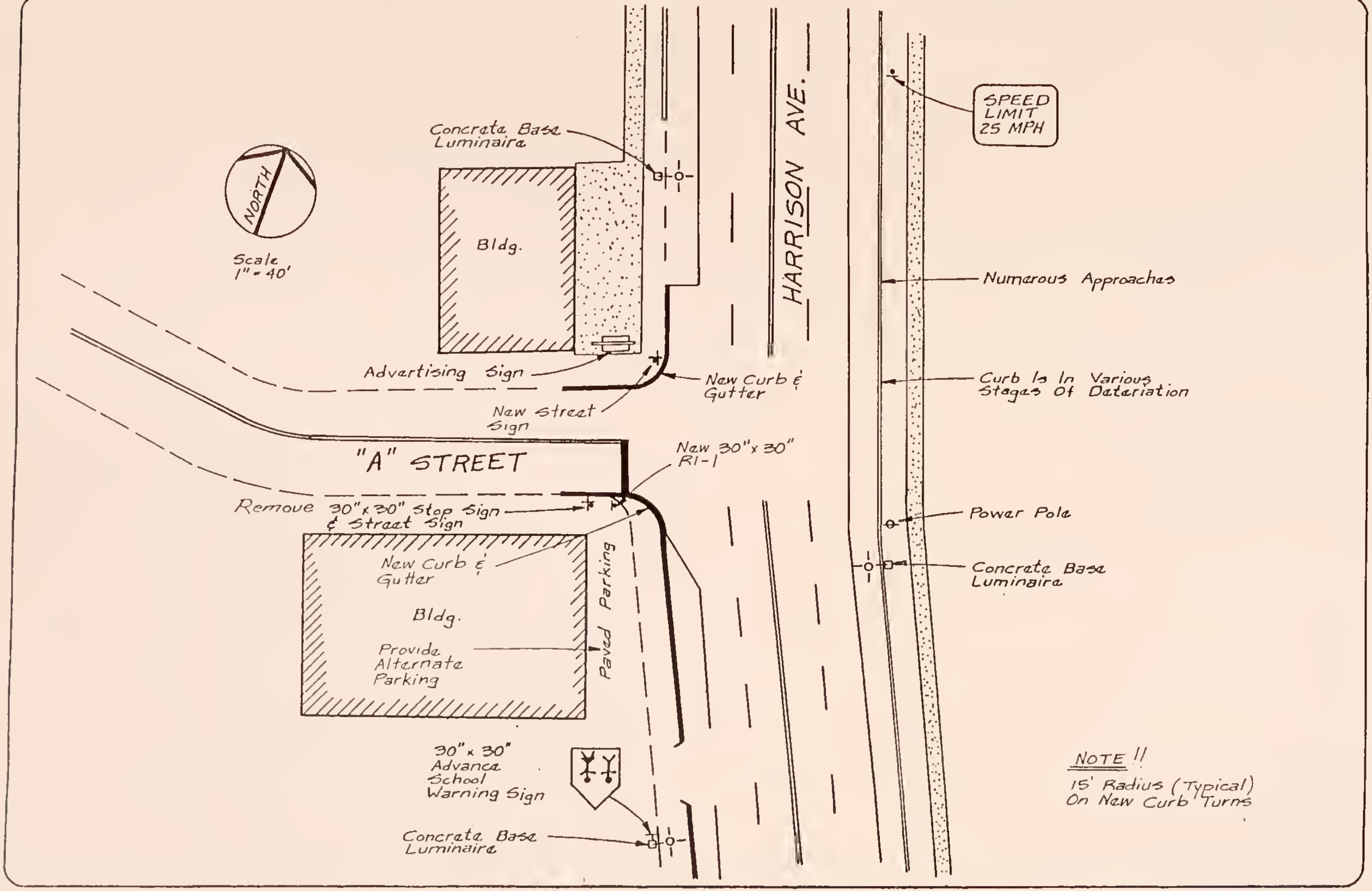
Survey Book No
Field Work by
Designed By
Drawn by
Checked by
Date

Client No

Project No

Sheet No

of



Project:

prepared by Christian, Spring, Sielbach & Associates
MONTANA
Consulting Engineering • Surveying • Photogrammetric Engineering

Sheet Title: Site No. 14
Short Term Improvements
Harrison - "A"

Client No.
Project No.
Sheet No.
of

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15

SITE NUMBER 15

HARRISON AVENUE - OLYMPIA STREET

LOCATION DESCRIPTION

The intersection of Harrison Avenue and Olympia Street is located in the fringe business district of Butte. Harrison Avenue is a principal north-south arterial and Olympia Street is a connector street which provides access to Oregan Avenue which is another north-south collector street which provides access to several east-west local streets and collectors. Elm Street, which is offset approximately 100 feet north of Olympia Street, provides an east continuation of Olympia Street to the east.

EXISTING CONDITIONS

Geometrics. The Existing Conditions Sketch details all of the existing geometrics of the intersection as well as surrounding topography. The approach grades on Harrison, Olympia, and Elm Street are less than one percent and sight distance is relatively unrestricted except at the Olympia Street approach. The northwest quadrant contains several sight restrictions. Foremost among those sight restrictions is the continual presence of vehicles which park in front of the tavern.

Signing. The Existing Condition Sketch outlines the existing signing. The signing is standard in application and adequate for the geometrics and traffic movements.

Pavement Markings. The existing pavement markings are standard in application and are highly visible. The only exception is the lack of pavement markings on Olympia Street and Elm Street.

Traffic Volumes. On the following page is a graphic illustration of the turning movement volume summary for a morning hour count. The expansion to Average Daily Traffic (ADT) of this hourly count procudes a north-south entering traffic volume of 17,400 and an east-west entering volume of 780. December, 1979 counts by automatic counters verified this expansion. Montana Department of Highways 1978 counts near this intersection indicate that the Harrison Avenue traffic volume is 16,950 ADT.

Traffic Operation. The intersection is laid out with enough delineation and guidance so that it operates fairly efficiently. The only noted problem was the sight restriction on the Olympia Street to Harrison Avenue approach.

ACCIDENT ANALYSIS

During the two and one-half year recording period from 1977 through June of 1979 there were six reported accidents. From the Accident Summary Sheet it can be seen that the majority of accidents occurred in clear weather on dry pavement during the daylight hours. The predominant accident type was the rear-end accident with the angle accident and the parked vehicle accident being the other two types. All accidents occurring at this intersection can be directly traced to the presence of parked vehicles on and around the north-west corner of Harrison - Olympia.

SHORT TERM IMPROVEMENTS

The Short Term Improvements Sketch indicates the recommended improvements. Most significant of these improvements is the relocation of the advertising sign and a restriction of parking in front of the tavern and also the restriction

GRAPHIC SUMMARY OF VEHICLE MOVEMENTS

Observer: Kent Brewer Date: Nov 15, 1979 Day: Thursday

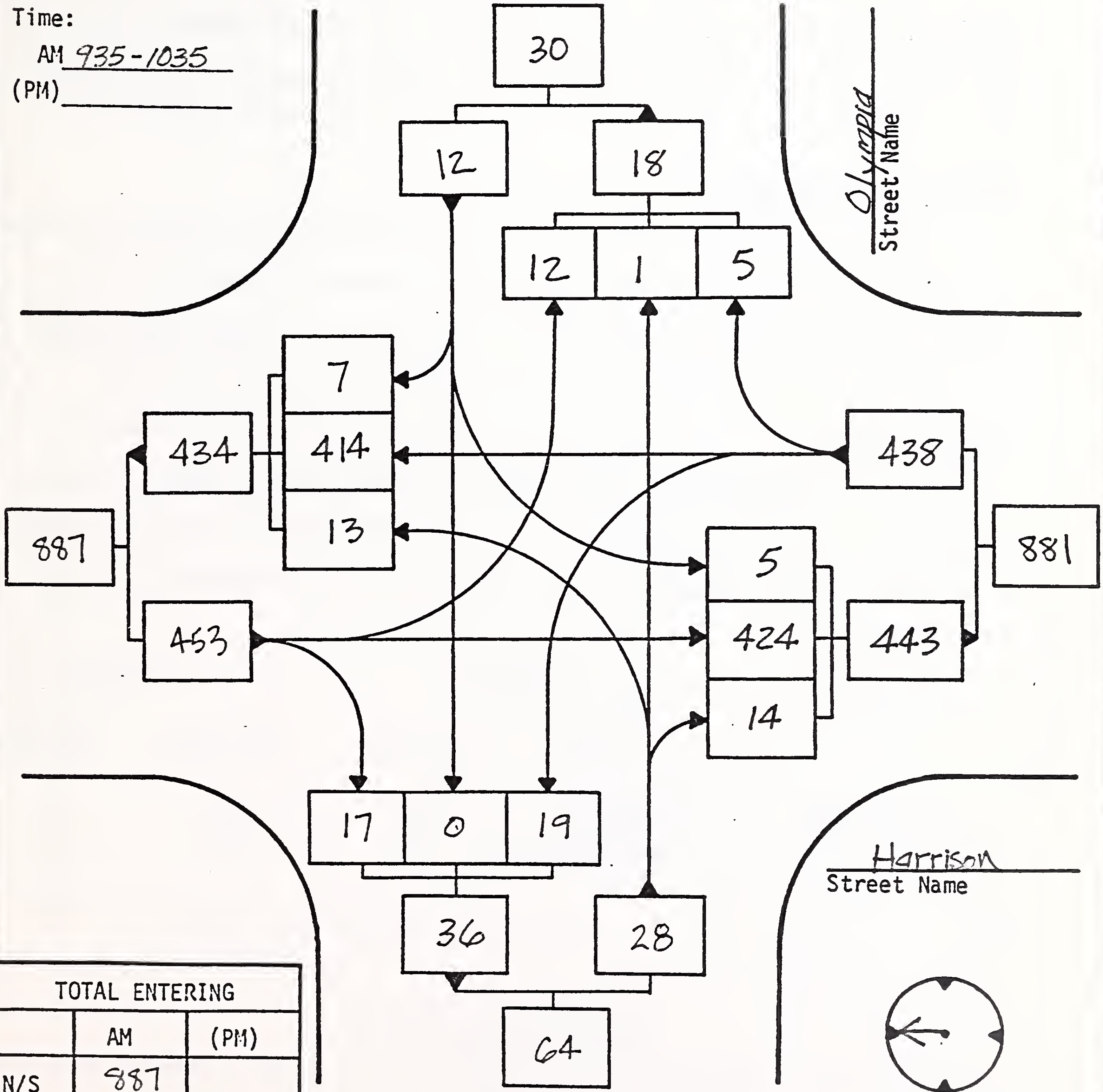
Intersection of: Harrison and: Olympia

City:

Time:

AM: 935-1035

(PM):



TOTAL ENTERING		
	AM	(PM)
N/S	887	
E/W	40	
Total	927	

of parking within 20 feet of the curb radius on the approach to Olympia. These restrictions should be further delineated with cross-hatch markings within the parking lane in that area.

The Department of Highways has indicated that the master signal coordinators in this area are not working. Since the exact extent of repairs necessary to make them operable is not known, the cost was not included. However, short term improvements should encompass proper signal control at adjacent intersections.

LONG TERM IMPROVEMENTS

Since the intersection has been recently upgraded to its current condition, (one year ago) the existing conditions will be adequate to handle all foreseeable traffic volumes and system uses in the future.

ECONOMIC BENEFIT

The anticipated accident reductions and related benefits derived from the recommended improvements are calculated below. The method of computation and forecasting accident reduction is detailed in the "Study Methodology" section of this report.

IMPROVEMENTS	ACCIDENTS		REDUCTION	
	Type	% of Total	% of Type	% of All Accidents
Short Term:	Angle	22	80	18
	Rear-End	33	80	26
	Parked Vehicle	11	90	5
	Total % Reduction of All Accidents			49

BENEFITS (Dollar Values)

(% Reduction) x (Accidents/Year) x (Useful Project Life) x (Average Severity)

Short Term: (0.49) x (2.4) x (5) x 3,667) = $21,560

PRELIMINARY COST ESTIMATE

Short Term Improvements

Item	Quantity	Unit	Unit Price	Cost
Pavement Markings (Plastic Overlay)	1800	L.F.	$ 1.75	$ 3,150
Relocate Advertising Sign	1	L.S.	1200.00	1,200
Curb and Gutter	20	L.F.	10.00	200
Miscellaneous Reparations	1	L.S.	500.00	500
Total Short Term Improvements Cost				$ 5,050

COST BENEFIT RATIO

The cost benefit ratio is calculated below. The cost of replacement and maintenance of pavement markings is not included.

Cost $/Benefit $ = 5,050/21,560 = 0.2342

ACCIDENT SUMMARY

SITE NUMBER 15 LOCATION Harrison - Olympia REPORTING PERIOD November 21, 1979

NUMBERS OF ACCIDENTS

MONTH	NO.
JAN.	1
FEB.	
MARCH	
APRIL	2
MAY	
JUNE	2
JULY	
AUGUST	
SEPT.	1
OCT.	
NOV.	
DEC.	

DAY OF WK.	NO.
SUN.	1
MON.	
TUES.	
WED.	2
THUR.	
FRI.	1
SAT.	2

WEATHER	NO.
CLEAR	5
RAIN	1
SNOW	
FOG	
OTHER	

ROAD CONDITION	NO.
DRY	5
WET	1
SNOWY	
ICY	
OTHER	

LIGHT CONDITION	NO.
DAY	4
DAWN OR DUSK	
DARK LIGHTED	2
DARK UN-LIGHTED	

ACCIDENT TYPE	NO.
ANGLE	2
LEFT TURN	
REAR END	3
HEAD ON	
SIDE SWIPE	
PARKED VEHICLE	1
BACKING	
FIXED OBJECT	
PED.	
ANIMAL	

YEAR & SEVERITY	NO.
1977 FATAL	
INJURY	
PROPERTY DAMAGE ONLY	2
1978 FATAL	
INJURY	
PROPERTY DAMAGE ONLY	1
1979 FATAL	
INJURY	1
PROPERTY DAMAGE ONLY	2

HAZARD INDEX

BASIC COMPUTATIONS

Site Number 15 Date November 21, 1979

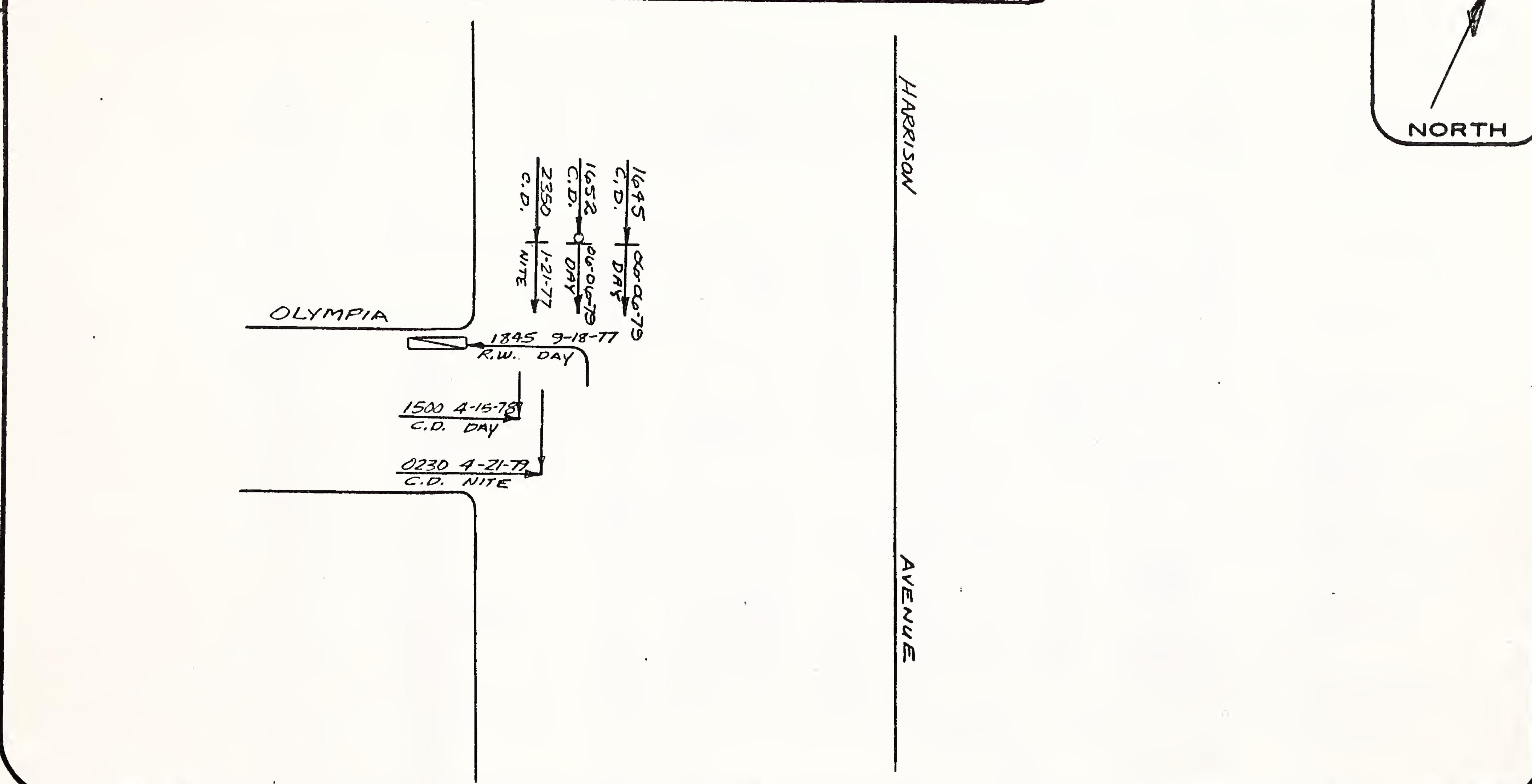
Description Harrison-Olympia

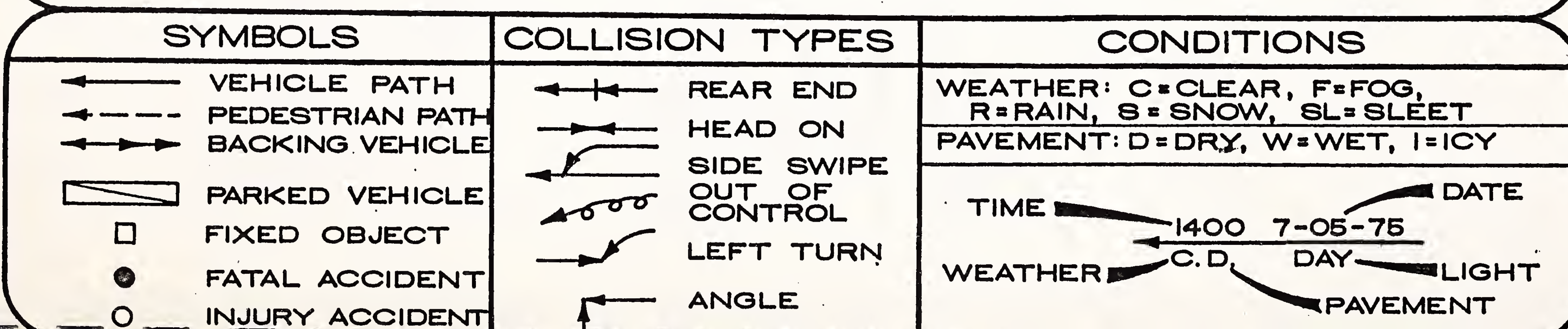
Indicator	Data Value		Indicator Value		Weight		Partial H.I.'s
Number of Accidents	2.4	acc/yr	37	x	0.145	=	5.37
Accident Rate	0.37	acc/MEV	10	x	0.199	=	1.99
Accident Severity	3.667	dollars	42	x	0.169	=	7.10
Volume/Capacity Ratio	0.17		35	x	0.073	=	2.56
Sight Distance Ratio	0.12	(wt.avg.)	95	x	0.066	=	6.27
Driver Expectancy	3.8	(wt.avg.)	63	x	0.132	=	8.32
Info. System Deficiencies	2.7	(wt.avg.)	45	x	0.102	=	4.59
			SUMS:		0.886*		36.20

$$\text{H.I.} = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{36.20}{0.886} = 40.86$$

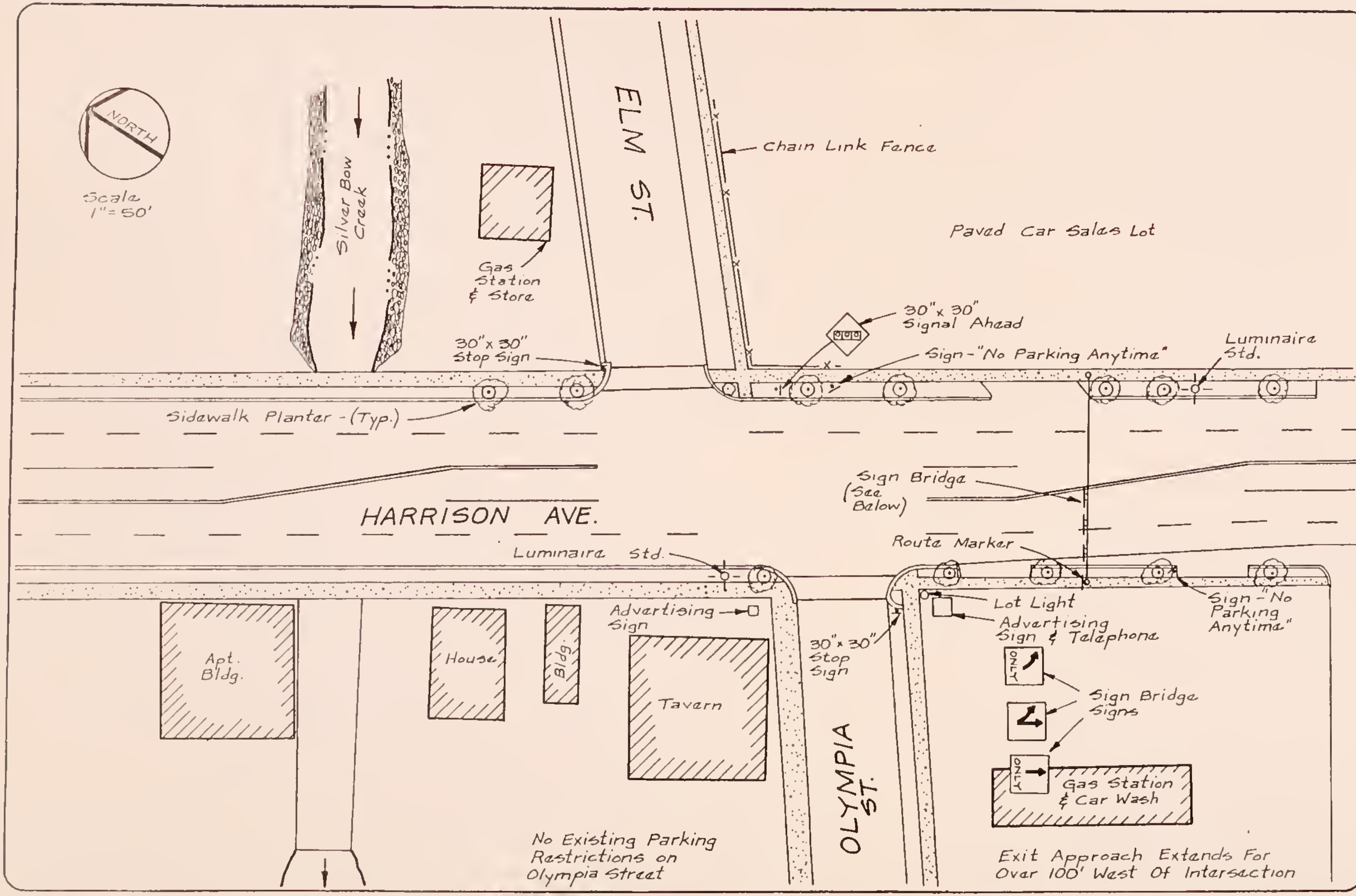
* The "Erratic Maneuvers" and "Traffic Conflict" indices were omitted from this study. Therefore the weight factors do not total 1.00 and all sites will be ranked on an 88.6% strength of evaluation relative to the FHWA Method.

COLLISION DIAGRAM



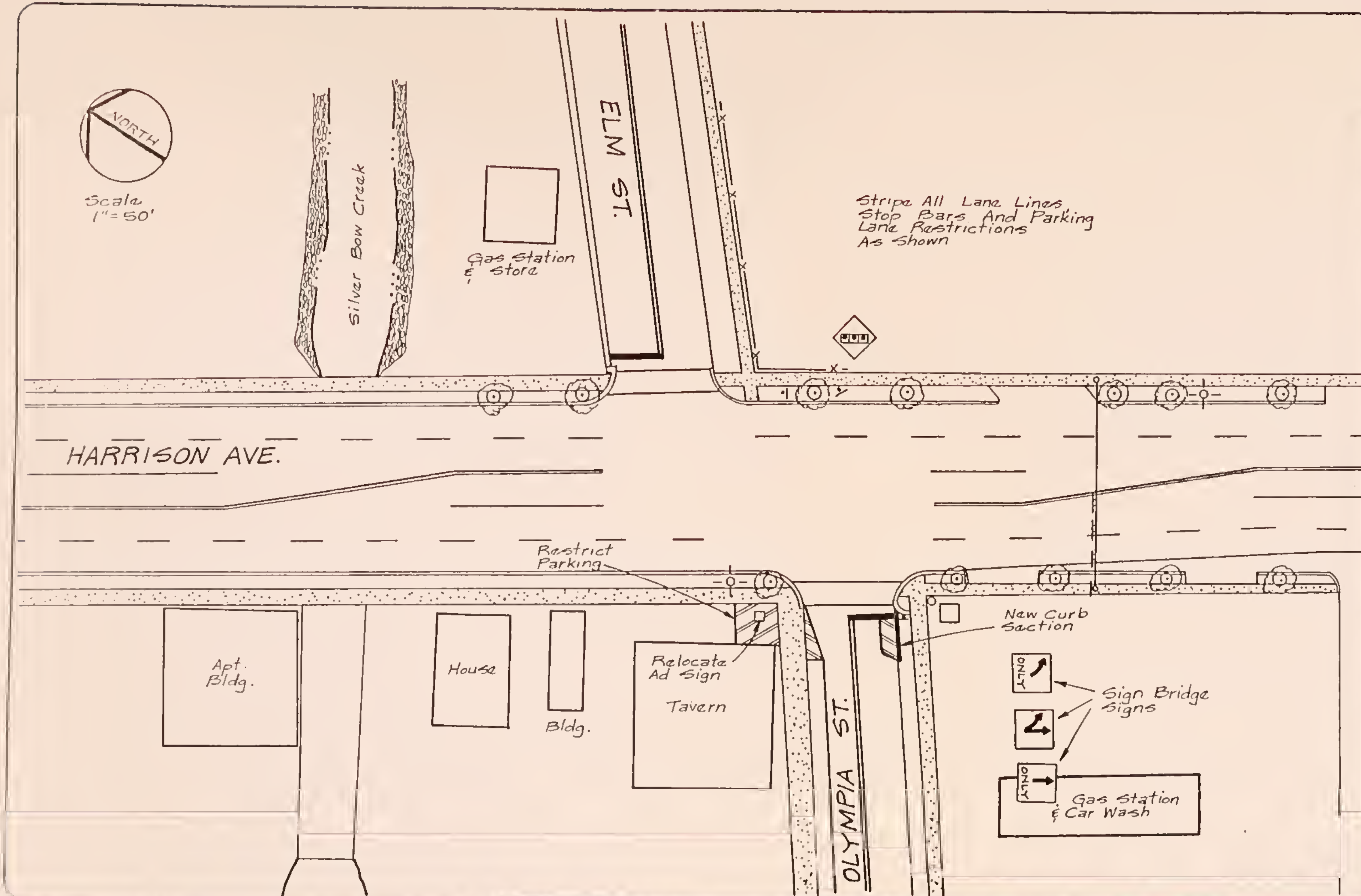


SITE NO. 15 - HARRISON - OLYMPIA



prepared by Christian, Spring, Sielbach & Associates
MONTANA

Sheet Title: Site No. 15 Existing Conditions Harrison - Olympia



Prepared by Christian, Spring, Sielbach & Associates
MONTANA
Consulting Engineering • Surveying • Photogrammetric Engineering

Sheet Title: Site No. 15
Short Term Improvements
Harrison - Olympia

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16

SITE NUMBER 16

MAIN STREET AND BROADWAY STREET

LOCATION DESCRIPTION

The intersection of Main and Broadway is in the heart of the Central Business District of Butte. Main Street is a principal north-south arterial and Broadway is an east-west collector street.

EXISTING CONDITIONS

Geometrics. The Existing Conditions Sketch shows the intersection geometrics and surrounding topography. The approach grades on Main Street are severe being in excess of 10 percent while the approach grades on Broadway are relatively mild. The intersection is surrounded on all corners by large multi-story buildings which are within 10 to 15 feet of the curb edge.

Signalization. The intersection is currently signalized and controlled by a pole mounted controller located in the northwest quadrant of the intersection. The controller is an Econolite, electro-mechanical fixed time controller. The total cycle length is 50 seconds with Main Street green time set at 25 seconds and Broadway green time set at 22 seconds. Both Main and Broadway receive a 3 second amber clearance. The intersection of Broadway and Main is tied into a progression system on Main Street involving five signals that operate on a poorly timed double offset system. (See page 45 of this report. Signal lenses are 8-inch and pedestrian head letter heights are 3 inches.

Signing. There is currently no street signing applicable to the intersection.

Pavement Markings. The current pavement markings are standard in application and deficient to the extent that the crosswalks and stop bars are not carried completely to the curb face.

Traffic Volumes. On the following sheet is a graphic summary of turning movement volumes during the peak evening hour. Included also are pedestrian counts across the legs of the intersection. Indicated on the volume summary sheet, are heavy left and right-turn movements on all approaches. Average Daily Traffic expansion using hourly, monthly, and daily expansion factors produced a north-south entering traffic volume of 6,550 and an east-west entering traffic volume of 4,470. Machine counts taken December, 1979 correlate very closely with the turn movement counting expansion. The Montana Department of Highways line count on Main Street north of this intersection indicated that the 1977 - 1978 average ADT was approximately 6,600 vehicles which correlates with current ADT.

Traffic Operations. The heavy occurrence of turning movements at this intersection combined with restrictive geometrics, sight distance restrictions and poor progression of Main Street signalization contribute to the relative congestion of the intersection. The calculated capacity of the intersection is much greater than the observed capacity of the intersection.

ACCIDENT ANALYSIS

During the two and one-half year reporting period from 1977 through June of 1979 there were eight reported accidents at this intersection. The Accident Summary Sheet provides a detailed breakdown of the type and condition of these accidents. The majority of these accidents occurred in clear weather conditions on dry pavement during the daylight hours and an equal number of angle, left-turn, rear-end and pedestrian accidents occurred.

GRAPHIC SUMMARY OF VEHICLE MOVEMENTS

Observer R. Marvin Date Nov. 14, 1979 Day Wednesday

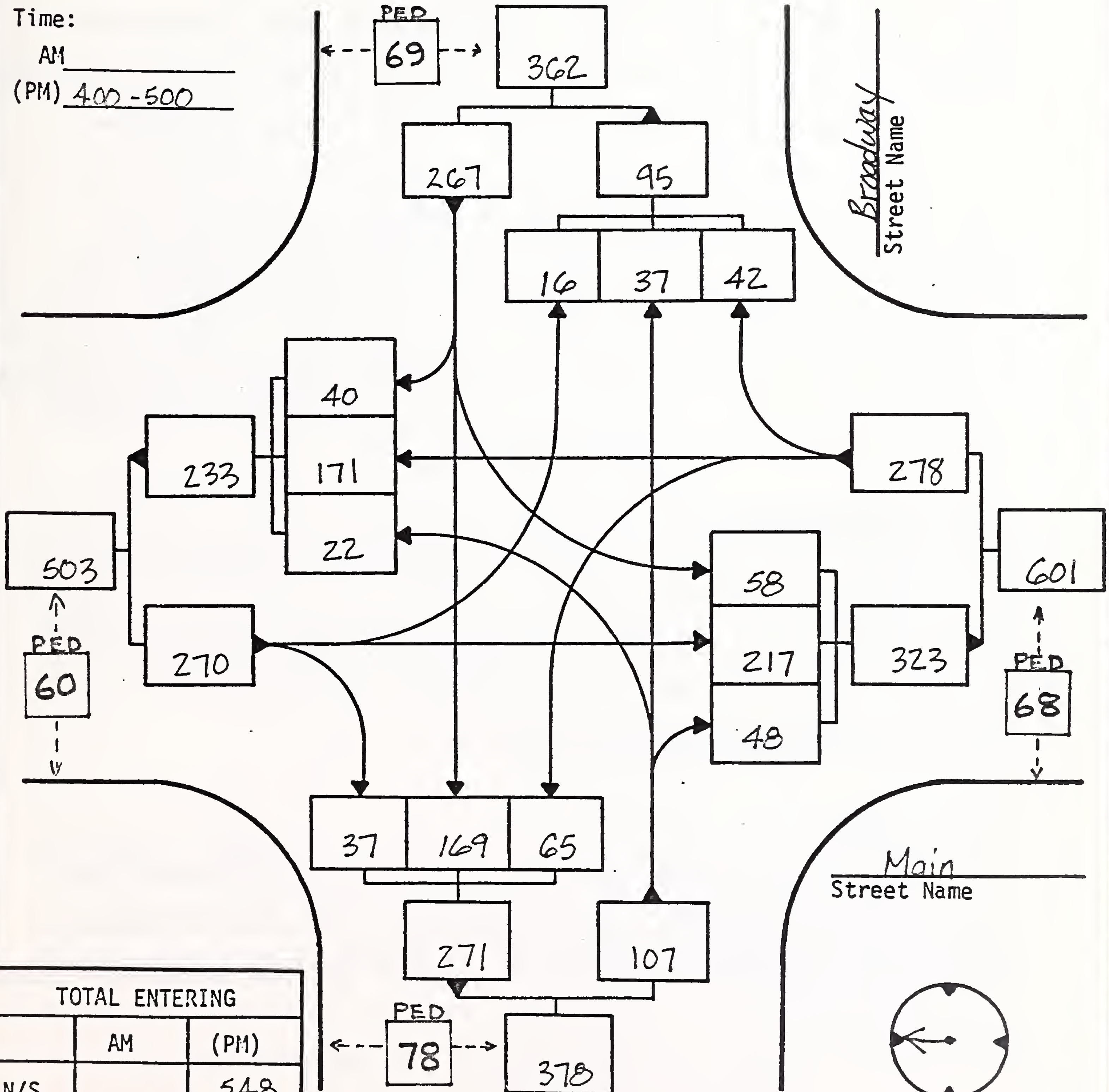
Intersection of Main and Broadway

City Butte, Montana

Time:

AM

(PM) 400-500



TOTAL ENTERING		
	AM	(PM)
N/S		548
E/W		374
Total		922

SHORT TERM IMPROVEMENTS

The Short Term Improvements Sheet details the striping and signing improvements recommended to improve the operation and safety of this intersection. The major aspect of these improvements is restriping which include left-turn lanes on all approaches. This improvement will coordinate with the recommended improvements further south on Mercury Street and Main. The installation of regulatory signs indicating lane usage on the signal mast arms will help enforce the lane usage in snow cover. Also the retiming of progression on Main Street is recommended. (See page 47 of this report) In addition it should be noted that the pedestrian signal on the southeast quadrant of the intersection should be repaired as it is currently not operable.

LONG TERM IMPROVEMENTS

Long term improvements at the intersection of Main and Broadway are heavily dependent on the entire circulation pattern of the Central Business District. Additional improvements beyond what is recommended through short term improvements cannot be reliably foreseen at this time.

ECONOMIC BENEFIT

The anticipated accident reductions and related benefits derived from the recommended improvements are calculated below. The method of computation and forecasting accident reduction is detailed in the "Study Methodology" section of this report.

IMPROVEMENTS	ACCIDENTS		REDUCTION	
	Type	% of Total	% of Type	% of All Accidents
SHORT TERM:	Angle	22	50	11
	Left-Turn	22	70	15
	Rear-End	22	30	7
	Pedestrian	22	50	11
	Total % Reduction of All Accidents			44

BENEFITS (Dollar Values)

(% Reduction) x (Accidents/Year) x (Useful Project Life) x (Average Severity)

Short Term: (0.44) x (3.2) x (5) x (6,978) = $49,130

PRELIMINARY COST ESTIMATE

Short Term Improvements

Item	Quantity	Unit	Unit Price	Cost
Pavement Markings (Plastic Overlay)	3,800	L.F.	$ 1.75	$ 6,650
Signs	9	Ea.	120.00	1,080
Repair Pedestrian Signal	1	L.S.	200.00	200
Miscellaneous Signal Timing Revisions	1	L.S.	400.00	400
Total Short Term Improvements Cost				$ 8,330

COST BENEFIT RATIO

The cost benefit ratio is calculated below. The cost of administration and engineering is not included nor is the cost of replacement and maintenance during the 5-year life.

Cost $/Benefit $ = 8,330/49,130 = 0.1696

ACCIDENT SUMMARY

SITE NUMBER 16 LOCATION Main - Broadway REPORTING PERIOD November 26, 1979

NUMBERS OF ACCIDENTS

MONTH	NO.
JAN.	1
FEB.	
MARCH	
APRIL	
MAY	1
JUNE	
JULY	
AUGUST	
SEPT.	1
OCT.	2
NOV.	2
DEC.	1

DAY OF WK.	NO.
SUN.	
MON.	2
TUES.	
WED.	
THUR.	2
FRI.	3
SAT.	1

WEATHER	NO.
CLEAR	6
RAIN	
SNOW	2
FOG	
OTHER	

ROAD CONDITION	NO.
DRY	5
WET	1
SNOWY	
ICY	2
OTHER	

LIGHT CONDITION	NO.
DAY	4
DAWN OR DUSK	2
DARK LIGHTED	1
DARK UN-LIGHTED	1

ACCIDENT TYPE	NO.
ANGLE	2
LEFT TURN	2
REAR END	2
HEAD ON	
SIDE SWIPE	
PARKED VEHICLE	
BACKING	
FIXED OBJECT	
PED.	2
ANIMAL	

YEAR & SEVERITY	NO.
1977 FATAL	
INJURY	
PROPERTY DAMAGE ONLY	3
1978 FATAL	
INJURY	2
PROPERTY DAMAGE ONLY	2
1979 FATAL	
INJURY	
PROPERTY DAMAGE ONLY	1

HAZARD INDEX

BASIC COMPUTATIONS

Site Number 16 Date November 26, 1979

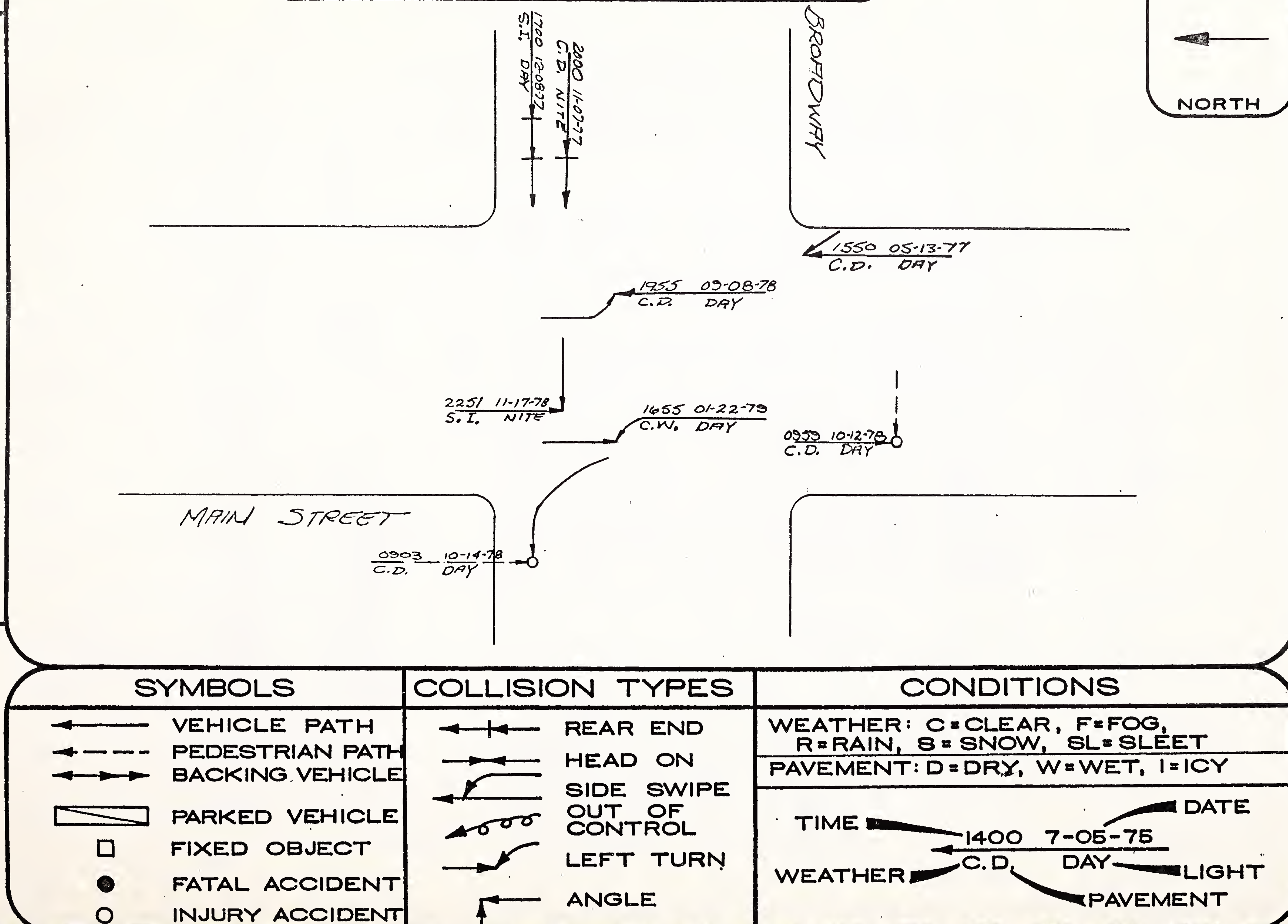
Description Main - Broadway

Indicator	Data Value		Indicator Value		Weight		Partial H.I.'s
Number of Accidents	3.2	acc/yr	42	x	0.145	=	6.09
Accident Rate	0.79	acc/MEV	19	x	0.199	=	3.78
Accident Severity	6,978	dollars	55	x	0.169	=	9.30
Volume/Capacity Ratio	0.22		40	x	0.073	=	2.92
Sight Distance Ratio	.37	(wt.avg.)	83	x	0.066	=	5.48
Driver Expectancy	3.0	(wt.avg.)	50	x	0.132	=	6.60
Info. System Deficiencies	4.0	(wt.avg.)	67	x	0.102	=	6.83
			SUMS:		0.886*		41.00

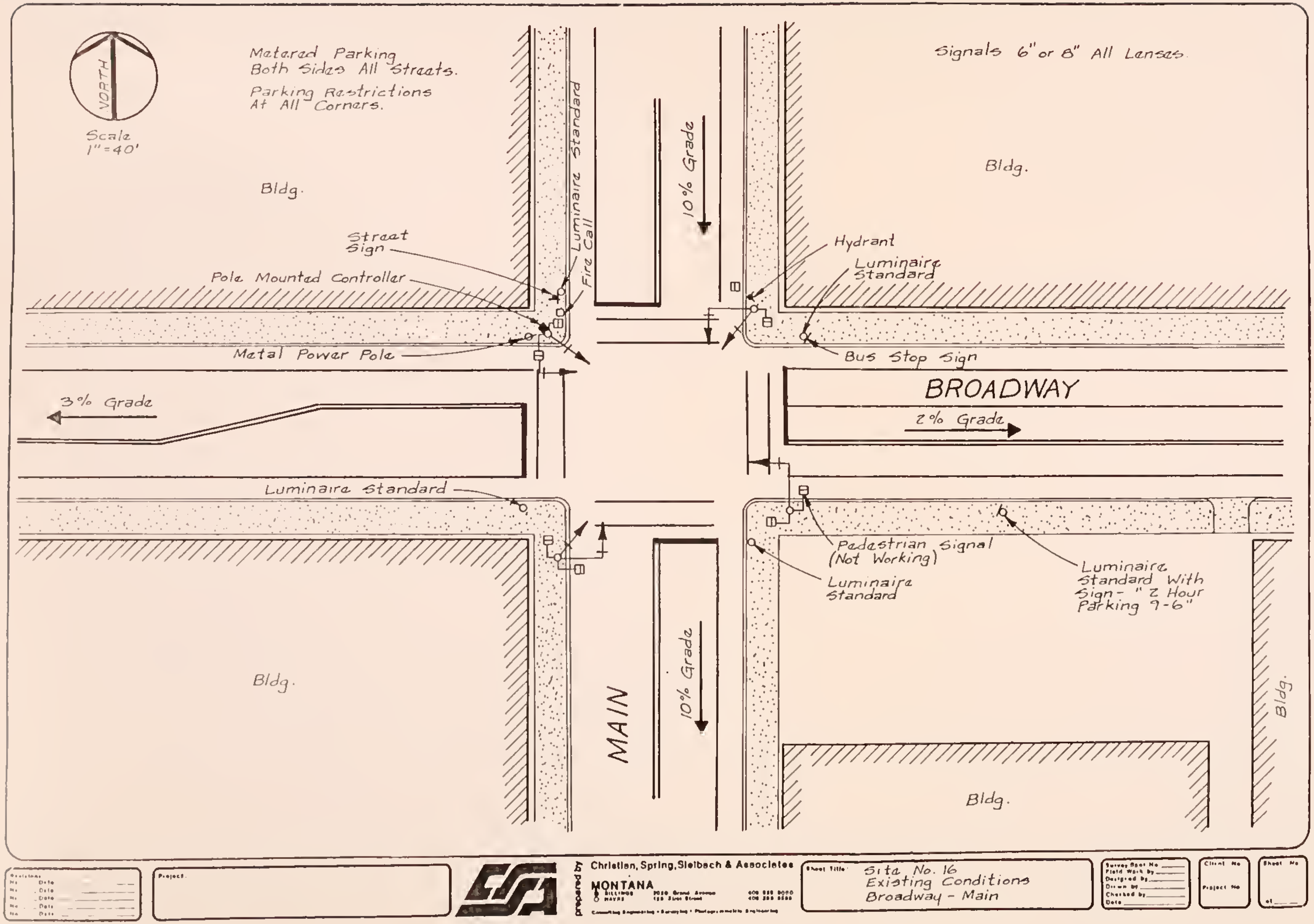
$$\text{H.I.} = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{41.00}{0.886} = 46.28$$

* The "Erratic Maneuvers" and "Traffic Conflict" indices were omitted from this study. Therefore the weight factors do not total 1.00 and all sites will be ranked on an 88.6% strength of evaluation relative to the FHWA Method.

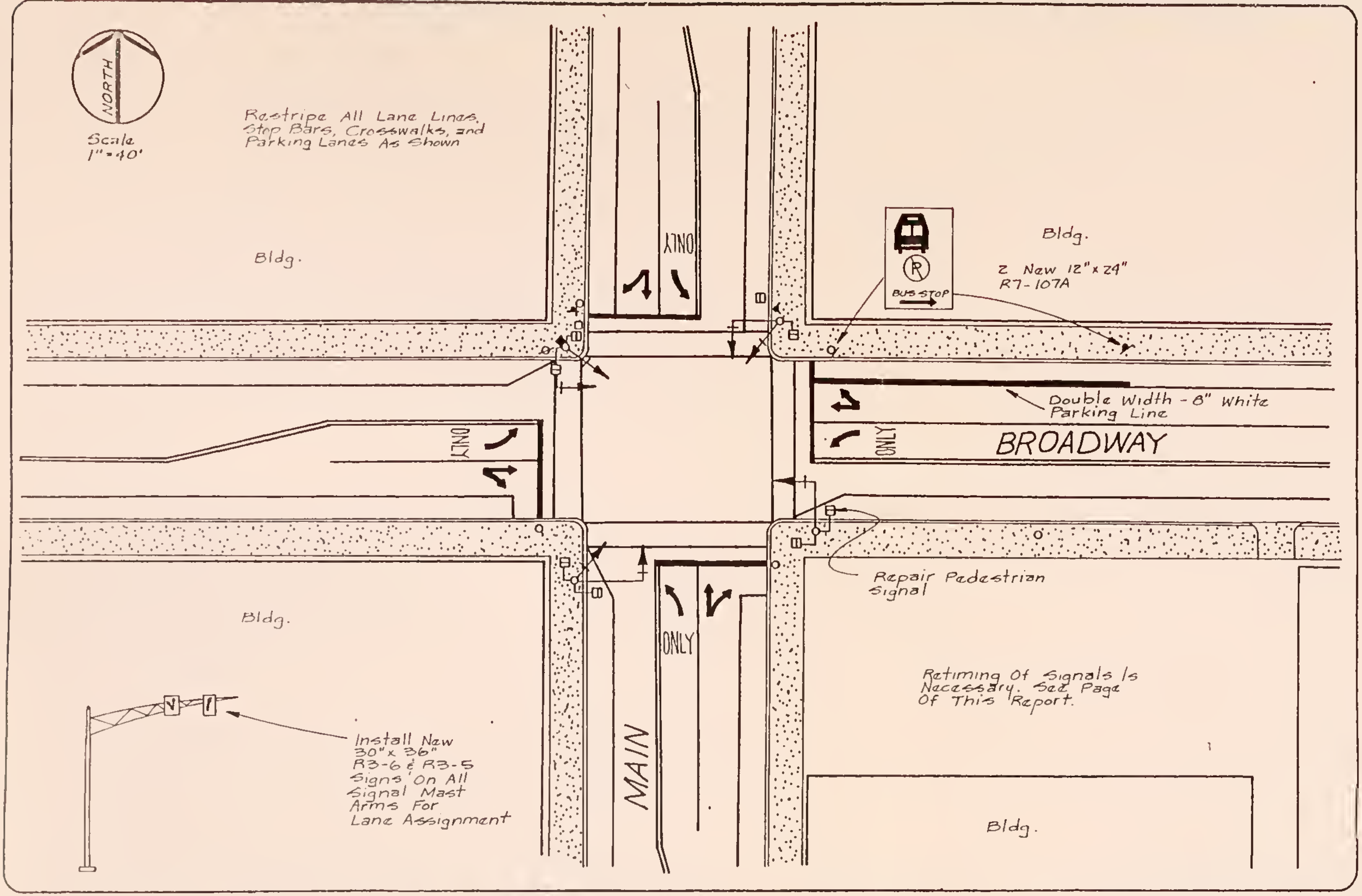
COLLISION DIAGRAM



SITE NO. 16 - MAIN - BROADWAY



NORTH
Scale 1"=40'
Metered Parking Both Sides All Streets.
Parking Restrictions At All Corners.
Signals 6" or 8" All Lenses.
Bldg.
Bldg.
Street Sign
Luminaire Standard
Fire Call
Pole Mounted Controller
Metal Power Pole
10% Grade
Hydrant
Luminaire Standard
Bus Stop Sign
BROADWAY
2% Grade
3% Grade
Luminaire Standard
Pedestrian Signal (Not Working)
Luminaire Standard
Luminaire Standard With Sign- "2 Hour Parking 9-6"
Bldg.
MAIN
10% Grade
Bldg.
Bldg.
Project:
prepared by
Christian, Spring, Sielbach & Associates
MONTANA
Sheet Title:
Site No. 16
Existing Conditions
Broadway - Main



Prepared by Christian, Spring, Sielbach & Associates
MONTANA

Sheet Title: Site No. 16
Short Term Improvements
Main - Broadway

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17

SITE NUMBER 17

MAIN STREET - GRANITE STREET

LOCATION DESCRIPTION

The intersection of Main Street and Granite Street is located in the heart of the central business district of Butte. Main Street is a north-south arterial and Granite is an east-west collector street.

EXISTING CONDITIONS

Geometrics. The Existing Conditions Sketch for Site No. 17 details the intersection geometrics and surrounding topography. The approach grades on Main Street are severe (greater than 12%) and the approach grades on Granite Street are moderate. The entire intersection areas is surrounded by multi-story buildings. The building setbacks from the face of curb are between 12 and 15 feet.

Signalization. The intersection is currently signalized and operates on a fixed time basis. Control is by a pole-mounted electro-mechanical controller. The signal cycle is 50 seconds which provides Main Street with a 22 second green and Granite Street with a 25 second green. Both Main and Granite Street have 3.0 second amber clearance periods. The signal is part of an integrated progression system on Main Street with the intersection being the northernmost signal of the five signal system. All lenses are 8-inch and all pedestrian heads have 3-inch high letters.

Signing. There is currently no existing signing pertaining to the intersection operation.

Pavement Markings. The existing pavement markings are standard to the extent of their application. However, crosswalks and stop bars are not carried to curb lines and Main Street centerline striping does not exist.

Traffic Volumes. The following sheet is a graphic summary of turning volume count taken during an afternoon hour. As can be seen there are heavy turning movements particularly on Main Street and all intersection legs are relatively equal in traffic volumes. An ADT expansion of the turning movement count was completed using hourly, daily, and monthly variation factors. An ADT for north-south entering traffic was expanded to 5700 vehicles and the east-west ADT was computed at 4500 entering vehicles. The 24-hour machine count taken in December of 1979 correlated quite closely with the hourly expansion figure. In 1978 the Montana Department of Highways took a line count immediately south of this intersection on Main Street and established the 1978 ADT at 6070 which is within a realistic range of the 1978 ADT expansion.

Traffic Operation. The intersection operates fairly efficiently, unlike the intersection of Main Street and Broadway immediately to the south. This intersection does not have the number of pedestrians nor the diverse turning movements that the intersection of Main and Broadway has.

GRAPHIC SUMMARY OF VEHICLE MOVEMENTS

Observer ~~Ken Behling~~ Date 11/15/79 Day Thursday

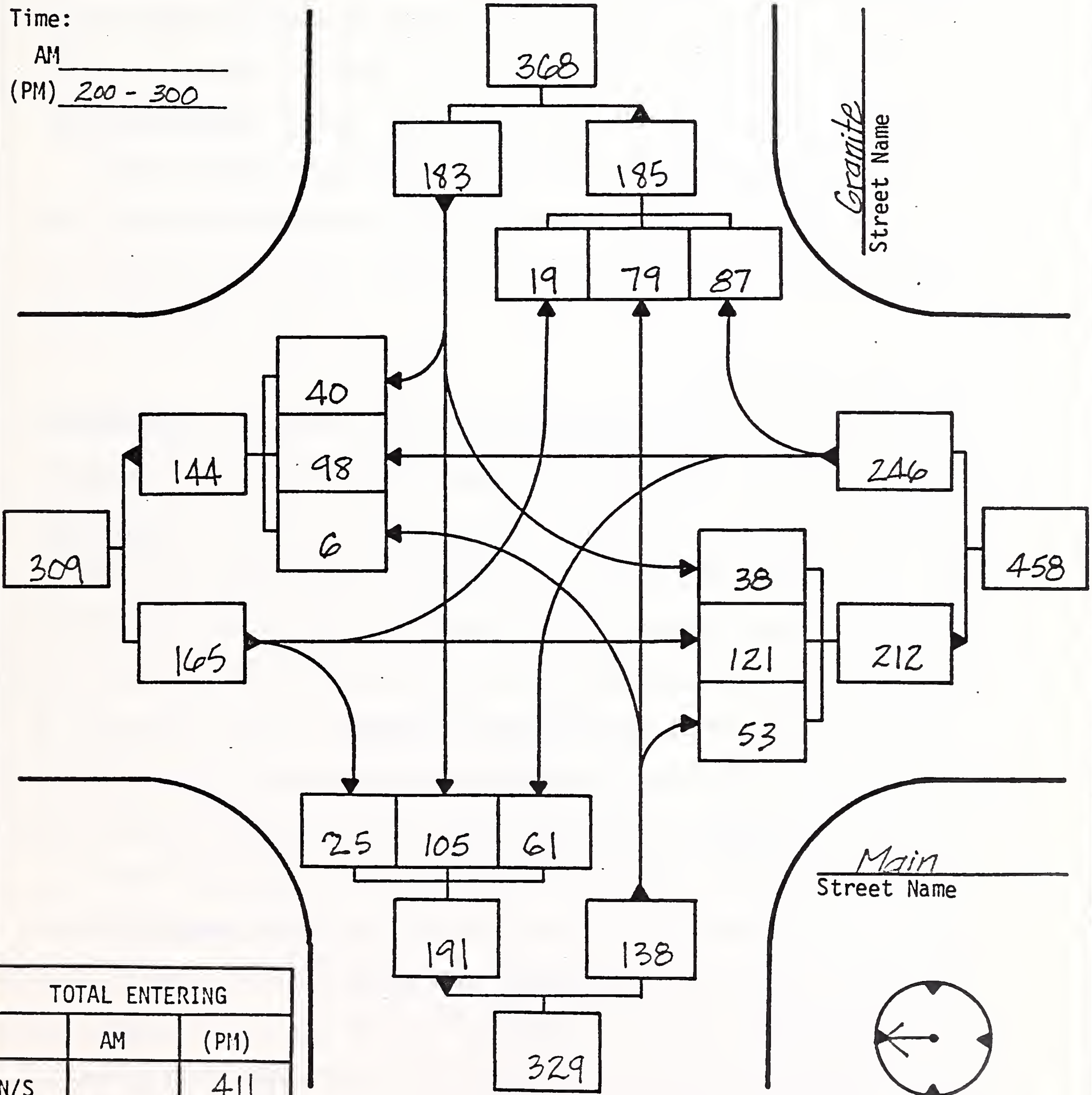
Intersection of Main and Granite

City Butte Montana

Time:

AM

(PM) 200 - 300



TOTAL ENTERING		
	AM	(PM)
N/S		411
E/W		321
Total		732

ACCIDENT ANALYSIS

In the two and one-half year period from 1977 to June of 1979 there were 7 reported accidents. The Accident Summary Sheet indicates that the majority of accidents occurred in clear weather on average pavemenet conditions during the daylight hours. The type of accident predominant at this intersection was the left-turn accident with side-swipes; parked vehicles and fixed object accident involvements being the lesser types. Unlike normal conditions at a signalized intersection, no rear-end accidents were found reported.

SHORT TERM IMPROVEMENTS

The Short Term Improvement Sketch indicates the recommended improvements to be implemented on a short term basis which include restriping of pavement markings to extend to crosswalks to curb lines and stop bars. In addition left-turn lanes are provided on Main Street to handle heavier left-turn movements at those locations. The left-turn bay designation on Main Street coordinates with the recommendations at Mercury and Main and Broadway and Main. In addition the retiming of the signals to provide a better progression in the north-south direction is recommended. (See page 47 of this report). As at Broadway and Main, the lane designation regulatory sign on the mast signal arms are recommended. Also the modification of the 8-inch red lenses on the mast arm for Main Street approaches should be accomplished by replacing them with a 12-inch red lens. This is considered necessary since the Granite Street intersection is the first in the series of five signalized intersections and the approach from the north is on a significant grade.

LONG TERM IMPROVEMENTS

Due to the established business district in Butte and stable system requirements of the CBD grid, long term improvements cannot be recommended on the basis of this study.

ECONOMIC BENEFIT

The anticipated accident reductions and related benefits derived from the recommended improvements are calculated below. The method of computation and forecasting accident reduction is detailed in the "Study Methodology" section of this report.

IMPROVEMENTS	ACCIDENTS		REDUCTION	
	Type	% of Total	% of Type	% of All Accidents
Short Term:	Left-turn	38	70	27
	Side-swipe	25	80	20
	Total % Reduction of All Accidents			47

BENEFITS (Dollar Values)

(% Reduction) x (Accidents/Year) x (Useful Project Life) x (Average Severity)

Short Term: (0.47) x (2.8) x (5) x (4,050) = $26,650

PRELIMINARY COST ESTIMATE

Short Term Improvements

Item	Quantity	Unit	Unit Price	Cost
Pavement Marking (Plastic Overlay)	4800	L.F.	$ 1.75	$ 8,400

(CONTINUED)

Item	Quantity	Unit	Unit Price	Cost
Signs	4	Each	$ 120.00	$ 480
Signal Lens Modification	1	Each	175.00	175
Miscellaneous Signal Timing	1	L.S.	400.00	400
Total Short Term Improvements				$ 9,935

COST BENEFIT RATIO

The cost-benefit ratio is calculated below. The cost of administration and engineering have not been included nor has the cost of replacement and maintenance of signing and striping during the five-year life of the report

Cost $/Benefit $ = 9,935/26,650 = 0.3728

ACCIDENT SUMMARY

SITE NUMBER 17 LOCATION Main - Granite REPORTING PERIOD November 27, 1979

NUMBERS OF ACCIDENTS

MONTH	NO.
JAN.	
FEB.	1
MARCH	
APRIL	1
MAY	2
JUNE	
JULY	1
AUGUST	
SEPT.	1
OCT.	
NOV.	1
DEC.	

DAY OF WK.	NO.
SUN.	1
MON.	1
TUES.	1
WED.	
THUR.	
FRI.	2
SAT.	2

WEATHER	NO.
CLEAR	5
RAIN	1
SNOW	
FOG	
OTHER	1

ROAD CONDITION	NO.
DRY	4
WET	3
SNOWY	
ICY	
OTHER	

LIGHT CONDITION	NO.
DAY	6
DAWN OR DUSK	
DARK LIGHTED	1
DARK UN-LIGHTED	

ACCIDENT TYPE	NO.
ANGLE	
LEFT TURN	3
REAR END	
HEAD ON	
SIDE SWIPE	2
PARKED VEHICLE	1
BACKING	
FIXED OBJECT	1
PED.	
ANIMAL	

YEAR & SEVERITY	NO.
1977 / FATAL	
INJURY	
PROPERTY DAMAGE ONLY	1
1978 / FATAL	
INJURY	
PROPERTY DAMAGE ONLY	3
1979 / FATAL	
INJURY	1
PROPERTY DAMAGE ONLY	2

HAZARD INDEX

BASIC COMPUTATIONS

Site Number 17 Date November 27, 1979

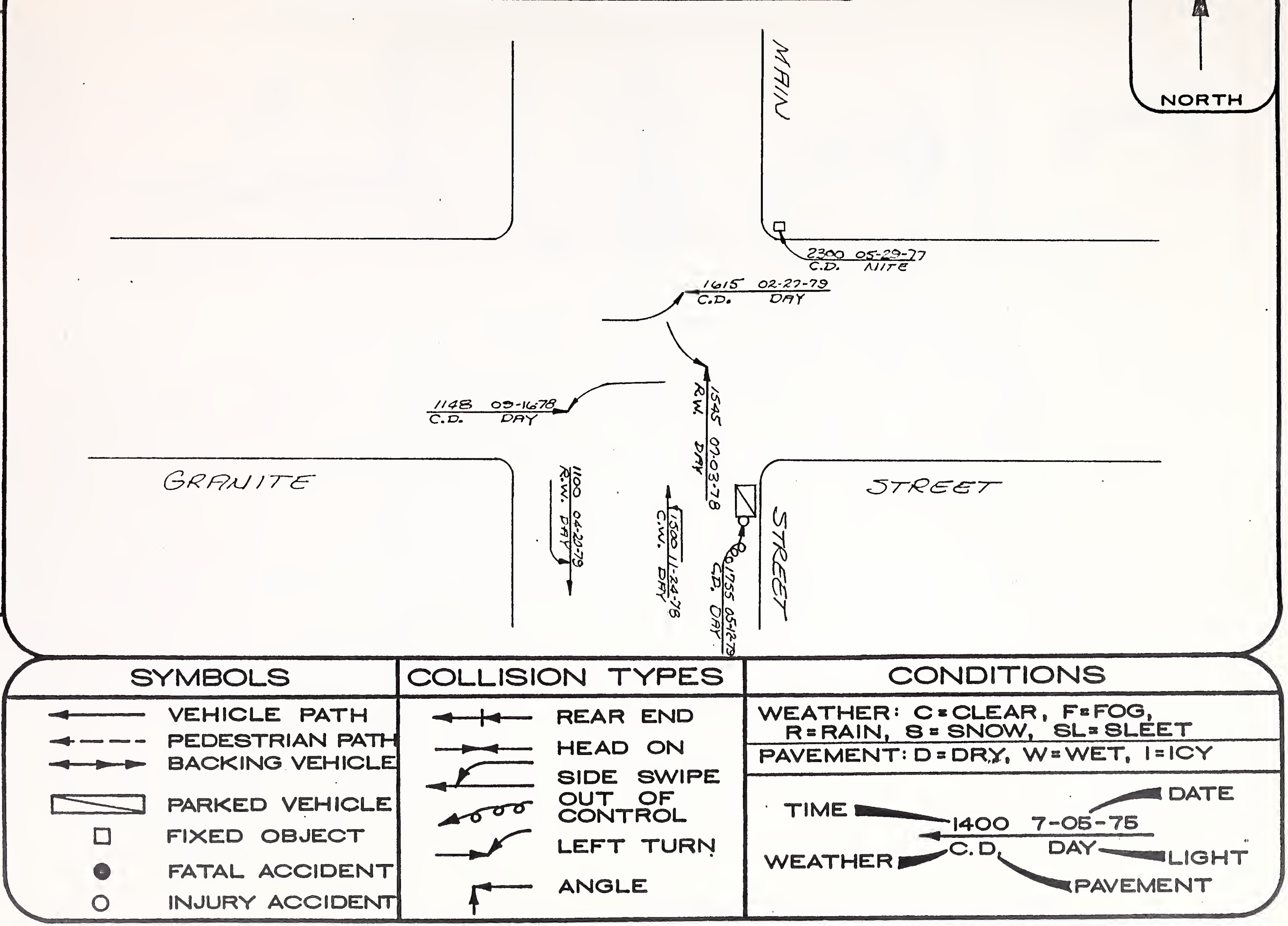
Description Main - Granite

Indicator	Data Value		Indicator Value		Weight		Partial H.I.'s
Number of Accidents	2.8	acc/yr	39	x	0.145	=	5.66
Accident Rate	0.71	acc/MEV	17	x	0.199	=	3.38
Accident Severity	4,050	dollars	44	x	0.169	=	7.44
Volume/Capacity Ratio	0.20		37	x	0.073	=	2.70
Sight Distance Ratio	.47	(wt.avg.)	75	x	0.066	=	4.95
Driver Expectancy	2.8	(wt.avg.)	47	x	0.132	=	6.20
Info. System Deficiencies	2	(wt.avg.)	33	x	0.102	=	3.37
			SUMS:		0.886*		33.70

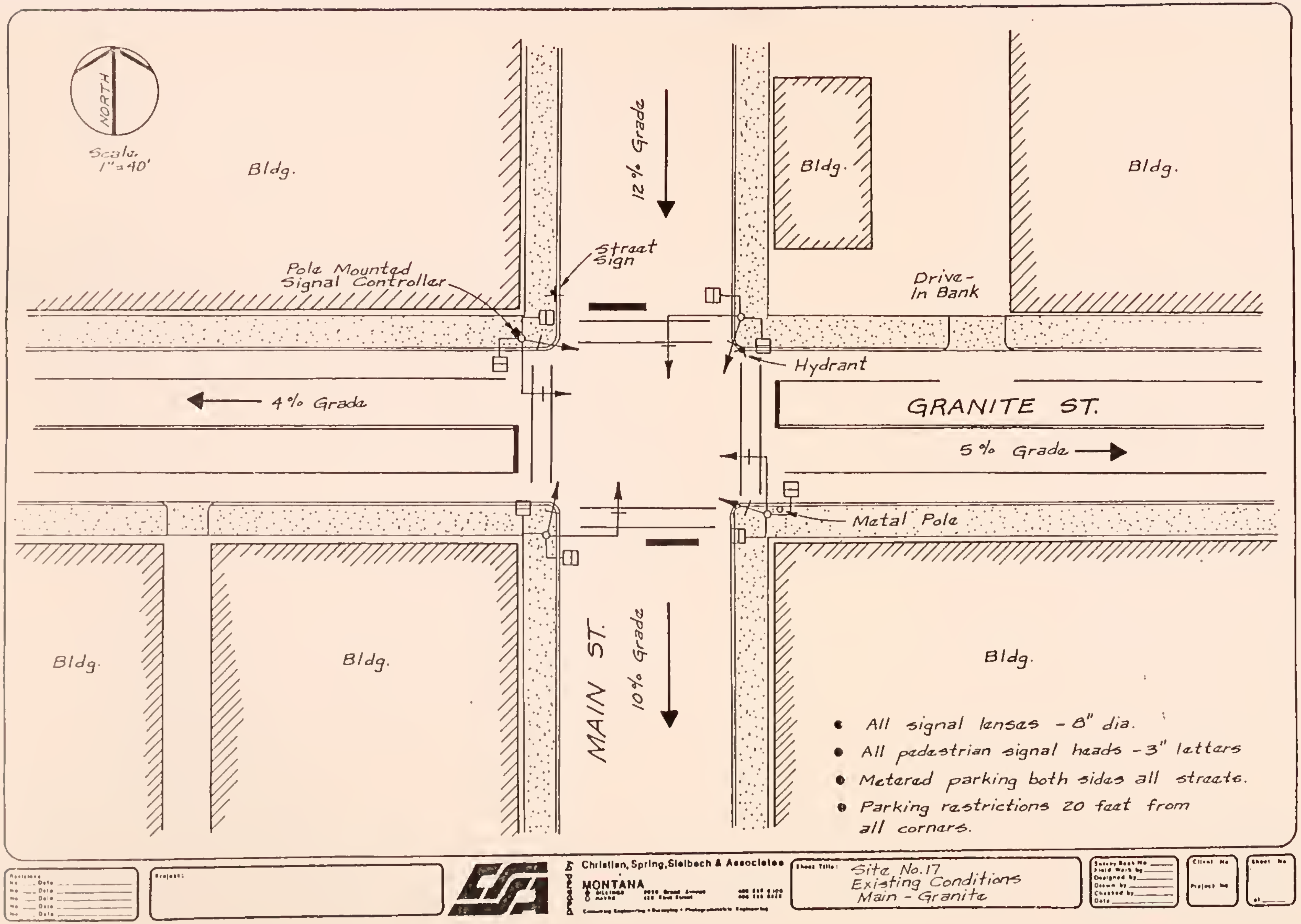
$$\text{H.I.} = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{33.70}{0.886} = 38.04$$

* The "Erratic Maneuvers" and "Traffic Conflict" indices were omitted from this study. Therefore the weight factors do not total 1.00 and all sites will be ranked on an 88.6% strength of evaluation relative to the FHWA Method.

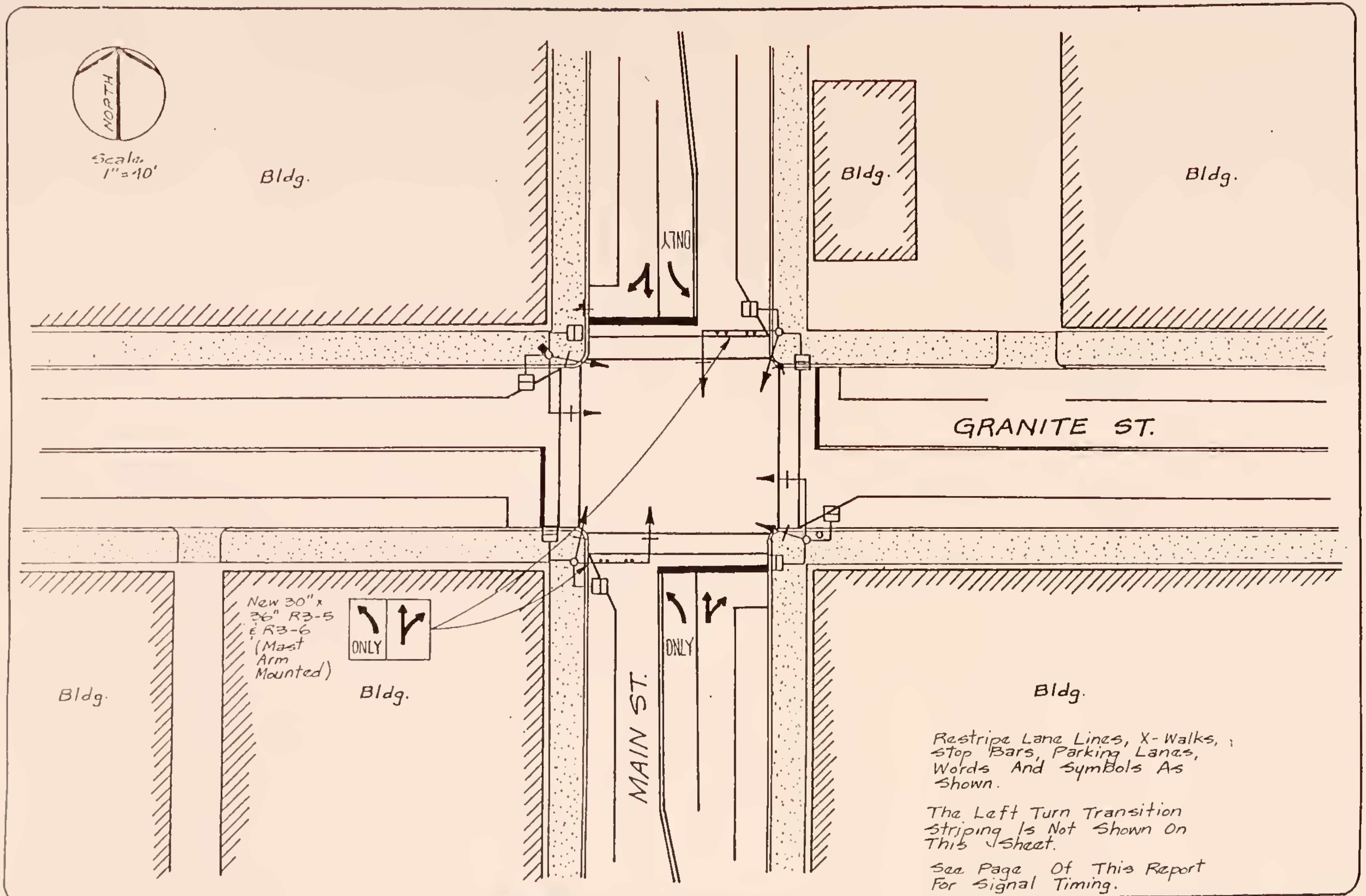
COLLISION DIAGRAM



SITE NO. 17 - MAIN - GRANITE



NORTH
Scale
1" = 40'
Bldg.
Bldg.
Bldg.
12% Grade
Street Sign
Pole Mounted Signal Controller
Drive-In Bank
Hydrant
4% Grade
GRANITE ST.
5% Grade
Metal Pole
Bldg.
Bldg.
MAIN ST.
10% Grade
Bldg.
• All signal lenses - 8" dia.
• All pedestrian signal heads - 3" letters
• Metered parking both sides all streets.
• Parking restrictions 20 feet from all corners.
Project:
prepared by
Christian, Spring, Sielbach & Associates
MONTANA
Sheet Title:
Site No. 17
Existing Conditions
Main - Granite



Revisions
Project:

prepared by Christian, Spring, Sielbach & Associates
MONTANA
Consulting Engineering • Surveying • Photogrammetric Engineering

Sheet Title: Site No. 17
Short Term Improvements
Main - Granite

Survey Book No.
Field Work by
Designed by
Drawn by
Checked by
Date

Client No.
Project No.

Sheet No.
of

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18

SITE NUMBER 18

UTAH AVENUE - PLATINUM STREET

LOCATION DESCRIPTION

The intersection of Utah and Platinum is on the southern fringe of the Central Business District of Butte. Utah Avenue is a north-south principal arterial and Platinum is an east-west collector street.

EXISTING CONDITIONS

Geometrics. The Existing Conditions Sketch details intersection geometrics and surrounding topography. Utah Avenue has a grade of approximately 5 percent sloping to the south while Platinum Street is relatively flat (approximately one percent). The intersection consists of various angle skewed approaches involving four different named streets, those being Utah Avenue, Platinum Avenue, Arizona Avenue and Ohio Street. The intersection is channelized as shown on the sketch.

Signalization. The intersection is currently signalized and is controlled by a pole-mounted semi-actuated controller, located in the southeast quadrant of Ohio and Arizona. Actuation is provided on Platinum and Ohio Streets. All signal lenses are 8 inches and all pedestrian signal heads have 3-inch high letters.

Signing. Various regulatory signs restricting turning movements and vehicle paths are existing. The signing is standard but inadequate.

Pavement Markings. The pavement markings indicated on the Existing Conditions Sketch are standard in application, however not sufficient for the complexity of intersection operation.

Traffic Volumes. The figure on the following page is a graphic summary of traffic turning volumes at this intersection during an evening hour period. An ADT expansion of the turning volumes produced a north-south entering volume of approximately 7000 vehicles and an east-west expansion of approximately 1300 entering vehicles. Twenty-four hour machine counts at this intersection during December, 1979 provided a close correlation with these ADT figures.

Traffic Operations. The operation of this intersection is relatively efficient considering the complexity of turn restrictions and geometrics. However, positive guidance and warning to motorists unfamiliar with the area is lacking, and creates problems particularly for the Utah northbound restriction for no right turn and the merge condition of Arizona with Utah north of the intersection.

ACCIDENT ANALYSIS

In the two and one-half year period from 1977 to June, 1979 there were eight reported accidents. The Accident Summary Sheet details the type and condition of these accidents. It can be seen that the majority of accidents occurred during clear weather conditions on dry roads during daylight hours. The majority of accidents were angle accidents with a single accident in the categorized types of left-turn, rear-end, head-on, side-swipe, and backing accidents. The predominance of the angle type accident is understandable due to the restricted sight distances involved in this intersection.

GRAPHIC SUMMARY OF VEHICLE MOVEMENTS

Observer K. Brewer - R. Marvin Date Nov. 15, 1979 Day Thursday

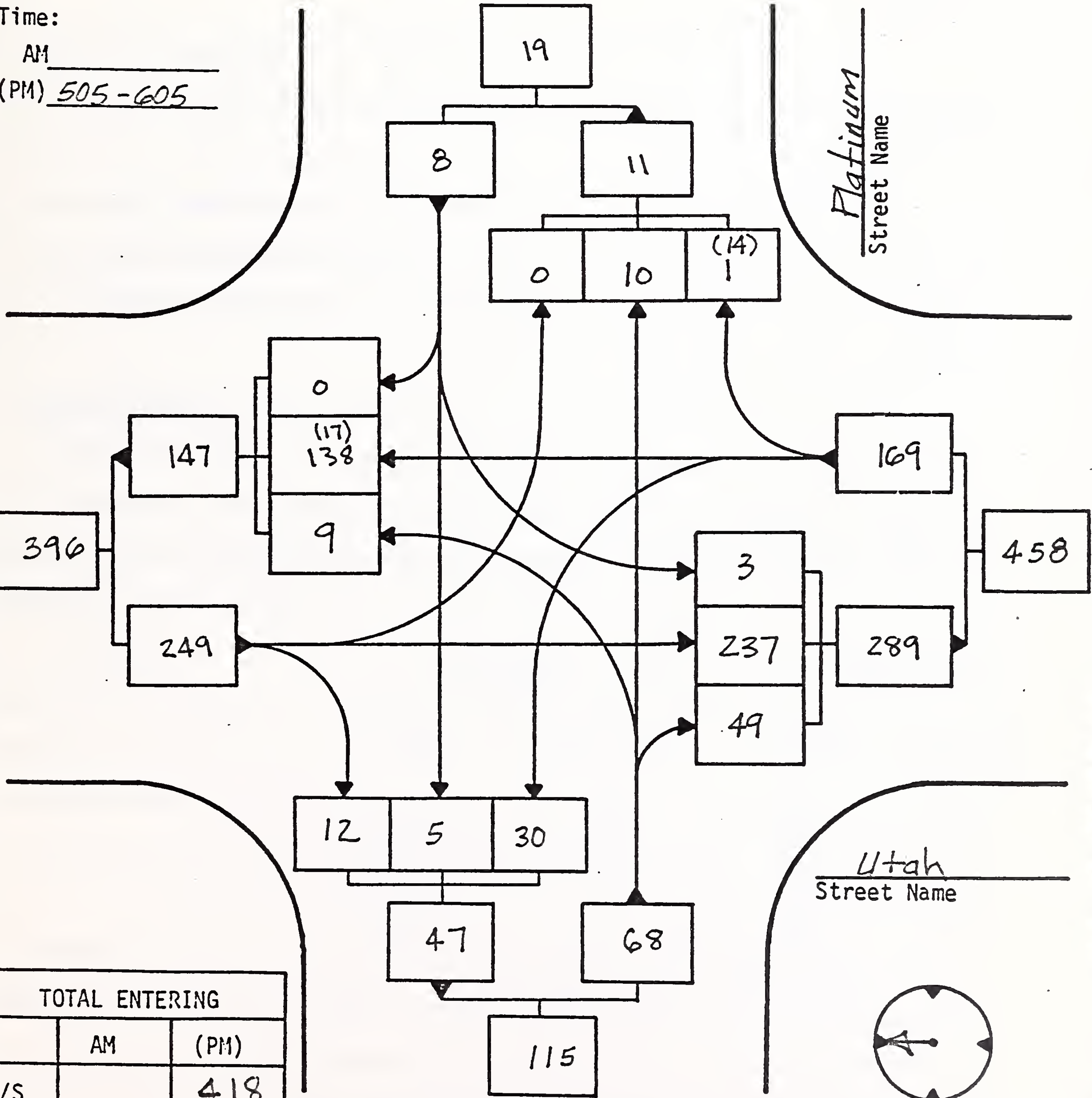
Intersection of Utah and Platinum

City Butte Montana

Time:

AM

(PM) 505-605



TOTAL ENTERING		
	AM	(PM)
N/S		418
E/W		76
Total		494

(From Arizona)

SHORT TERM IMPROVEMENTS

The Short Term Improvement Sketch details the recommended improvements for this intersection. It involves a wide range of striping and signing modifications and includes signal improvements. These improvements are listed as follows:

1. The pavement striping should be upgraded to be more restrictive on the use of lanes. This will reduce the variation in the number and positioning of vehicle paths.

2. Lane control, regulatory signs mounted on the northbound mast arm will provide a positive guidance for lane use during snow cover or when the pavement symbols or arrows are not readily seen. These signs also help reinforce the "no right turn" restriction.

3. The parking restrictions on the northbound Utah approach should be signed to avoid cars blocking the outside traffic lane. Left turns should be restricted on the northbound Arizona approach to avoid additional conflict movements that are not really needed in this particular intersection arrangement.

4. Lane regulation signs on mast arms for the Arizona northbound approach and the Ohio Street westbound approach should be installed.

5. The "no parking" zones and channelization on the merge area of Arizona and Utah should be striped to limit the angle and degree of transition approach for the merge movement. A guide sign should be installed in direct alignment for westbound Ohio Street approach movements indicating the required vehicle path for turning movements onto Utah Street and Platinum Street.

6. The movement from Platinum eastbound onto Utah southbound should be restricted on the red signal indication due to the sight distance restrictions and the approach velocity of southbound Utah traffic. Therefore, a "no turn on red" sign should be mounted on the signal mast arm.

7. New 36"x36" "signal ahead" warning signs should be placed on both apprACHES from eastbound Platinum Street and southbound Utah Avenue. All mast mounted signal indications on Utah Avenue and Platinum Street approaches should be modified to include 12-inch red lenses.

LONG TERM IMPROVEMENTS

Without the availability of a detailed systems study which would evaluate the present operation of this intersection in relationship to the entire system of arterial and collector street within this area, it is not possible to recommend a long term improvement. Long term improvements would require substantial geometric changes involving excessive funding.

ECONOMIC BENEFIT

The anticipated accident reductions and related benefits derived from the recommended improvements are calculated below. The method of computation and forecasting accident reduction is detailed in the "Study Methodology" section of this report.

IMPROVEMENTS	ACCIDENTS		REDUCTION	
	Type	% of Total	% of Type	% of All Accidents
Short Term:	Angle	38	80	30
	Left-Turn	12	30	4
	Rear-End	12	10	1
	Head-On	12	50	6
	Side-Swipe	12	50	6
	Backing	12	50	11
	Total % Reduction of All Accidents			58

BENEFITS (Dollar Values)

(% Reduction) x (Accidents/Year) x (Useful Project Life) x (Average Severity)

Short Term: (0.58) x (3.2) x (5) x (4,838) = $44,900

PRELIMINARY COST ESTIMATE

Short Term Improvements

Item	Quantity	Unit	Unit Price	Cost
Pavement Marking (Plastic Overlay)	6500	L.F.	$ 1.75	$11,375
Pindown Curb Island	1	L.S.	2200.00	2,200
Signs	18	Ea.	170.00	3,060
Signal Lenses Modification	4	Ea.	175.00	700
Miscellaneous Signal Timing	1	L.S.	400.00	400
Total Short Term Improvements Cost				$17,735

COST BENEFIT RATIO

The cost benefit ratio is calculated below. The costs do not include the following:

Administrative
Engineering
Replacement
Maintenance

Cost $/Benefit $ = 17,735/44,900 = 0.3950

ACCIDENT SUMMARY

SITE NUMBER 18 LOCATION Utah - Platinum REPORTING PERIOD November 27, 1979

NUMBERS OF ACCIDENTS

MONTH	NO.
JAN.	
FEB.	
MARCH	2
APRIL	
MAY	
JUNE	1
JULY	1
AUGUST	
SEPT.	
OCT.	3
NOV.	
DEC.	1

DAY OF WK.	NO.
SUN.	
MON.	2
TUES.	1
WED.	
THUR.	2
FRI.	1
SAT.	2

WEATHER	NO.
CLEAR	8
RAIN	
SNOW	
FOG	
OTHER	

ROAD CONDITION	NO.
DRY	7
WET	1
SNOWY	
ICY	
OTHER	

LIGHT CONDITION	NO.
DAY	6
DAWN OR DUSK	1
DARK LIGHTED	1
DARK UN-LIGHTED	

ACCIDENT TYPE	NO.
ANGLE	3
LEFT TURN	1
REAR END	1
HEAD ON	1
SIDE SWIPE	1
PARKED VEHICLE	
BACKING	1
FIXED OBJECT	
PED.	
ANIMAL	

YEAR & SEVERITY	NO.
1977 FATAL	
INJURY	
PROPERTY DAMAGE ONLY	2
1978 FATAL	
INJURY	1
PROPERTY DAMAGE ONLY	3
1979 FATAL	
INJURY	
PROPERTY DAMAGE ONLY	2

HAZARD INDEX

BASIC COMPUTATIONS

Site Number 18 Date November 27, 1979

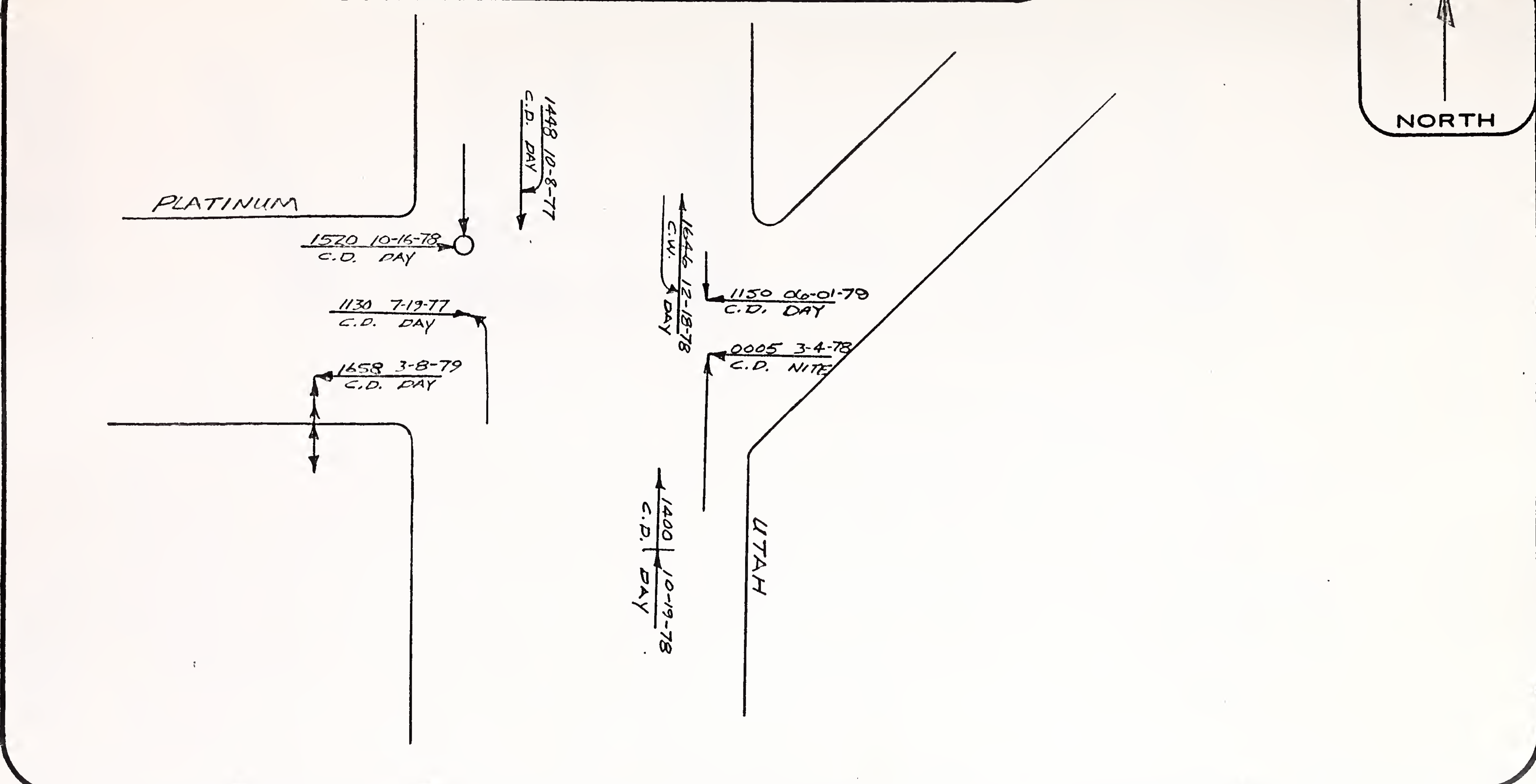
Description Utah - Platinum

Indicator	Data Value		Indicator Value		Weight		Partial H.I.'s
Number of Accidents	3.2	acc/yr	41	x	0.145	=	5.95
Accident Rate	1.09	acc/MEV	25	x	0.199	=	4.98
Accident Severity	4,838	dollars	47	x	0.169	=	7.94
Volume/Capacity Ratio	0.10		27	x	0.073	=	1.97
Sight Distance Ratio	0.20	(wt.avg.)	92	x	0.066	=	6.07
Driver Expectancy	4.3	(wt.avg.)	72	x	0.132	=	9.50
Info. System Deficiencies	3.7	(wt.avg.)	62	x	0.102	=	6.32
			SUMS:		0.886*		42.73

$$\text{H.I.} = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{42.73}{0.886} = 48.23$$

* The "Erratic Maneuvers" and "Traffic Conflict" indices were omitted from this study. Therefore the weight factors do not total 1.00 and all sites will be ranked on an 88.6% strength of evaluation relative to the FHWA Method.

COLLISION DIAGRAM



SITE NO. 18 - UTAH - PLATINUM

SYMBOLS	
←——	VEHICLE PATH
←- - -	PEDESTRIAN PATH
←→→	BACKING VEHICLE
▭	PARKED VEHICLE
□	FIXED OBJECT
●	FATAL ACCIDENT
○	INJURY ACCIDENT

COLLISION TYPES
REAR END
HEAD ON
SIDE SWIPE
OUT OF CONTROL
LEFT TURN
ANGLE

CONDITIONS

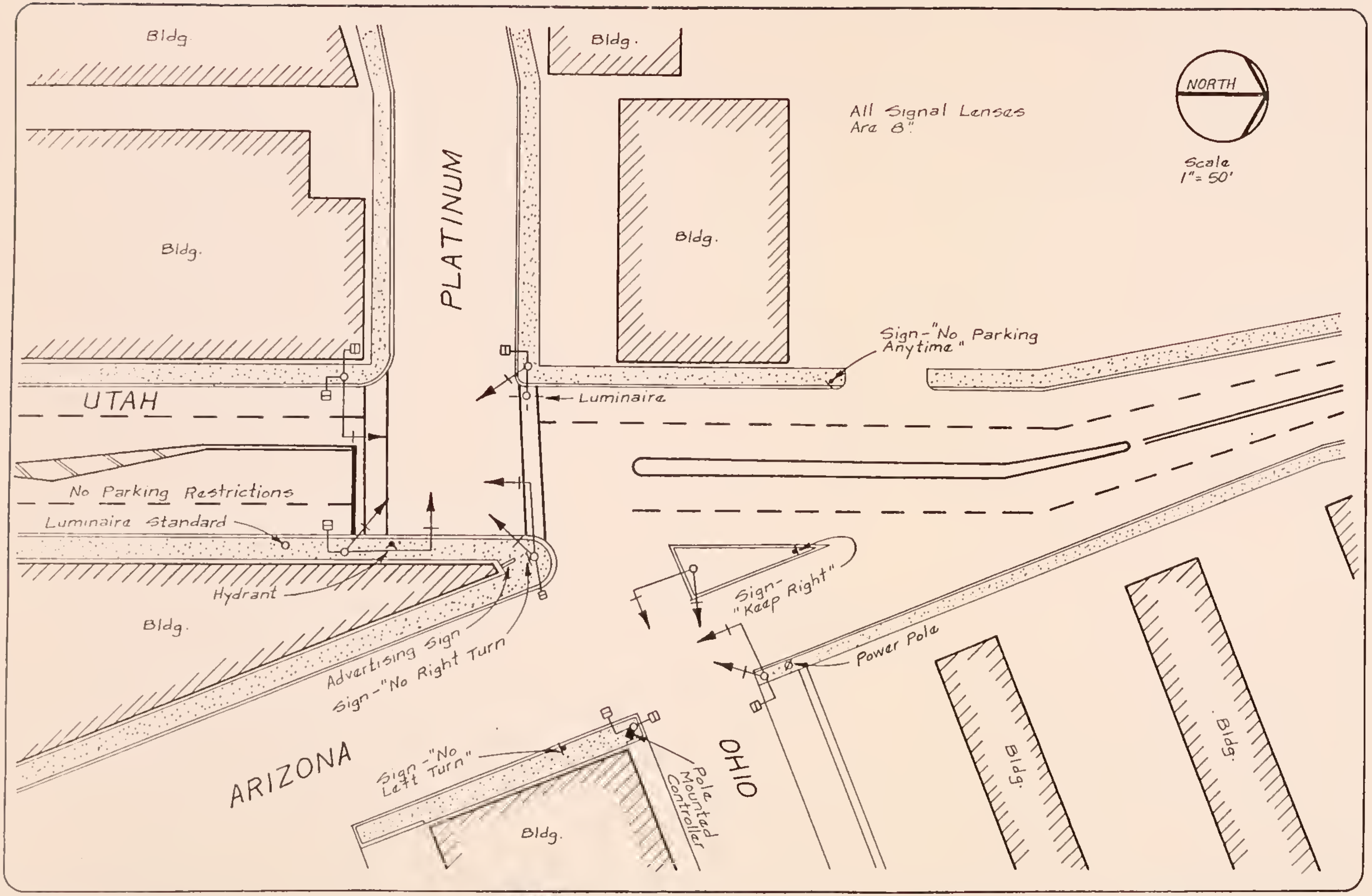
WEATHER: C=CLEAR, F=FOG, R=RAIN, S=SNOW, SL=SLEET

PAVEMENT: D=DRY, W=WET, I=ICY

TIME 1400 7-05-75 DATE

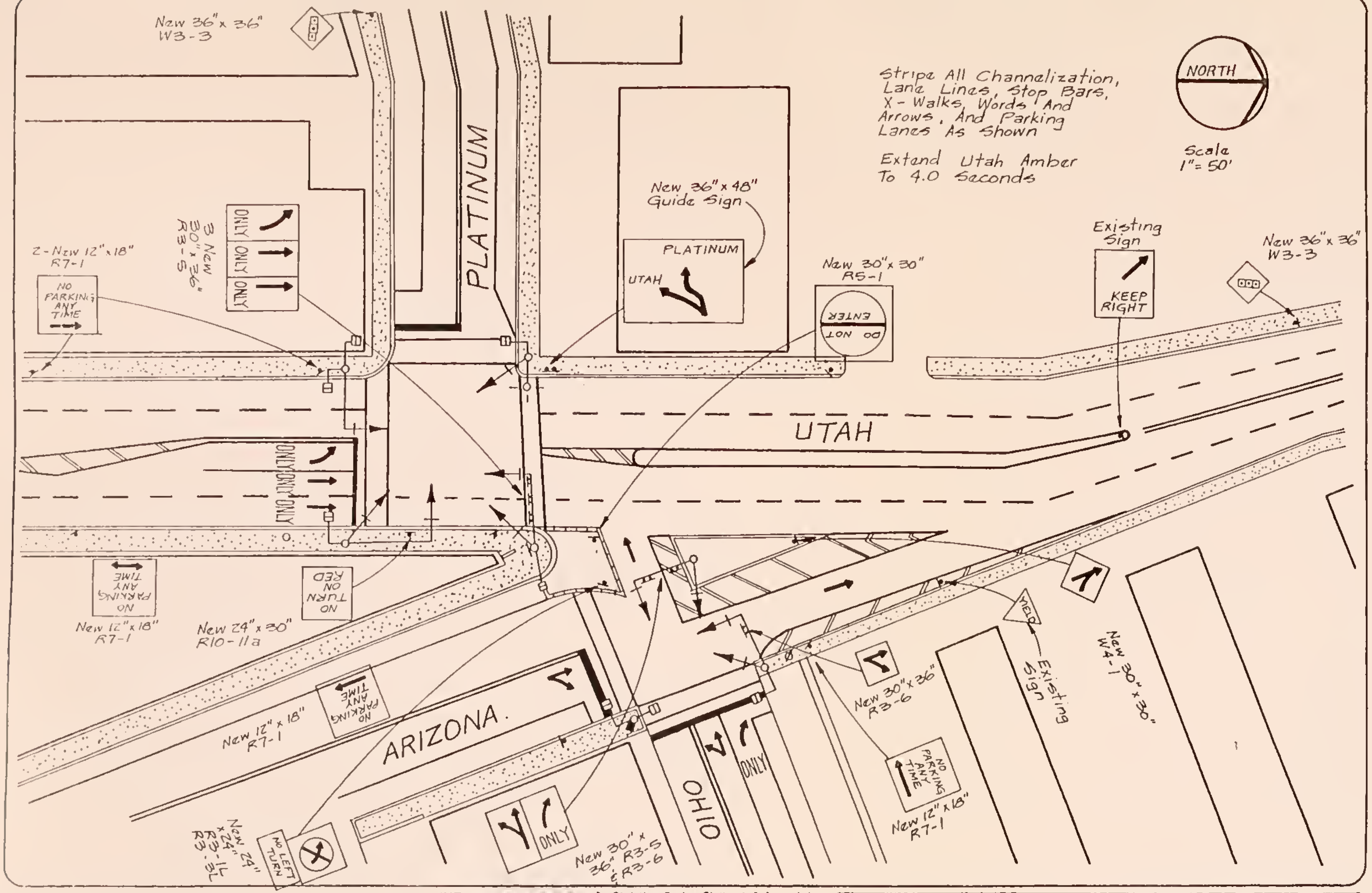
WEATHER C.D. DAY LIGHT

PAVEMENT



Christian, Spring, Sielbach & Associates
MONTANA

Sheet Title: Site No. 18
Existing Conditions
Utah - Platinum



Christian, Spring, Sielbach & Associates

MONTANA

Sheet Title: Site No. 18
Short Term Improvements
Utah - Platinum

SITE 19

SITE NUMBER 19

IDAHO STREET - PARK STREET

LOCATION DESCRIPTION

The intersection of Park and Idaho is located in the Central Business District of Butte. Park Street is an east-west principal arterial and Idaho Street is a local street.

EXISTING CONDITIONS

Geometrics. The Existing Conditions Sketch details intersection geometrics and surrounding topography. The approach grades on Idaho Street are in excess of 7 percent and the approach grades on Park are approximately 2 percent. There are buildings located on each corner within 10 to 12 feet of the curb line.

Signalization. The intersection of Idaho and Park is currently signalized and is controlled by a Crouse Hinds Solid State, fixed time controller. The total cycle length is 50 seconds. Park Street receives 26 seconds of green time while Idaho Street receives 18 seconds green time. Both approach streets have 3.0 seconds amber clearance intervals. All red lens on the signal mast arm are 12-inch diameter. All pedestrian signals are 3-inch letters.

Signing. There is only one sign existing in the immediate area of the intersection. That sign is the advanced school crosswalk sign for the crossing one block west of the intersection. There are also "no parking anytime" signs located along the south side of Park Street.

Pavement Markings. The existing pavement markings on Park Street are inlaid plastic and are standard in application. There are apparently no existing pavement markings on Idaho Street.

Traffic Volumes. The figure on the following page shows a summary of 4-5 P.M. turning movement counts at this intersection. The Average Daily Expansion of this count by applying hourly, daily and monthly factors would produce a volume of 1900 vehicles for north-south entering traffic and 6400 vehicles for east-west entering traffic. The automatic machine count over a 24-hour period in December, 1979 produced a similar ADT expansion at this intersection. The Montana Department of Highways does not have any permanent or annual count stations near this intersection.

Traffic Operations. The intersection oeprates fairly efficiently during most hours of the day. The low traffic counts at mid-day periods would indicate that minimum signal warrants based on volume are not met at this intersection.

ACCIDENT ANALYSIS

Over the two and one-half year period between 1977 and June of 1979, there were seven reported accidents at this location. The Accident Summary Sheet details the type and conditions of these accidents. From this sheet it can be seen that all the accidents occurred during week days and the majority of them occurred in clear weather with various pavement conditions. All accidents occurred during the daylight hours with the angle accident being the most predominant type of accident. Accidents involving parked vehicles were the second monst common with the other two accidents being rear-end accidents and a backing accident. The Collision Diagram illustrates the direction and other pertinent aspects of each accident.

GRAPHIC SUMMARY OF VEHICLE MOVEMENTS

Observer Ken Behling Date 11/28 - 11/29 Day Wed. -Thurs.

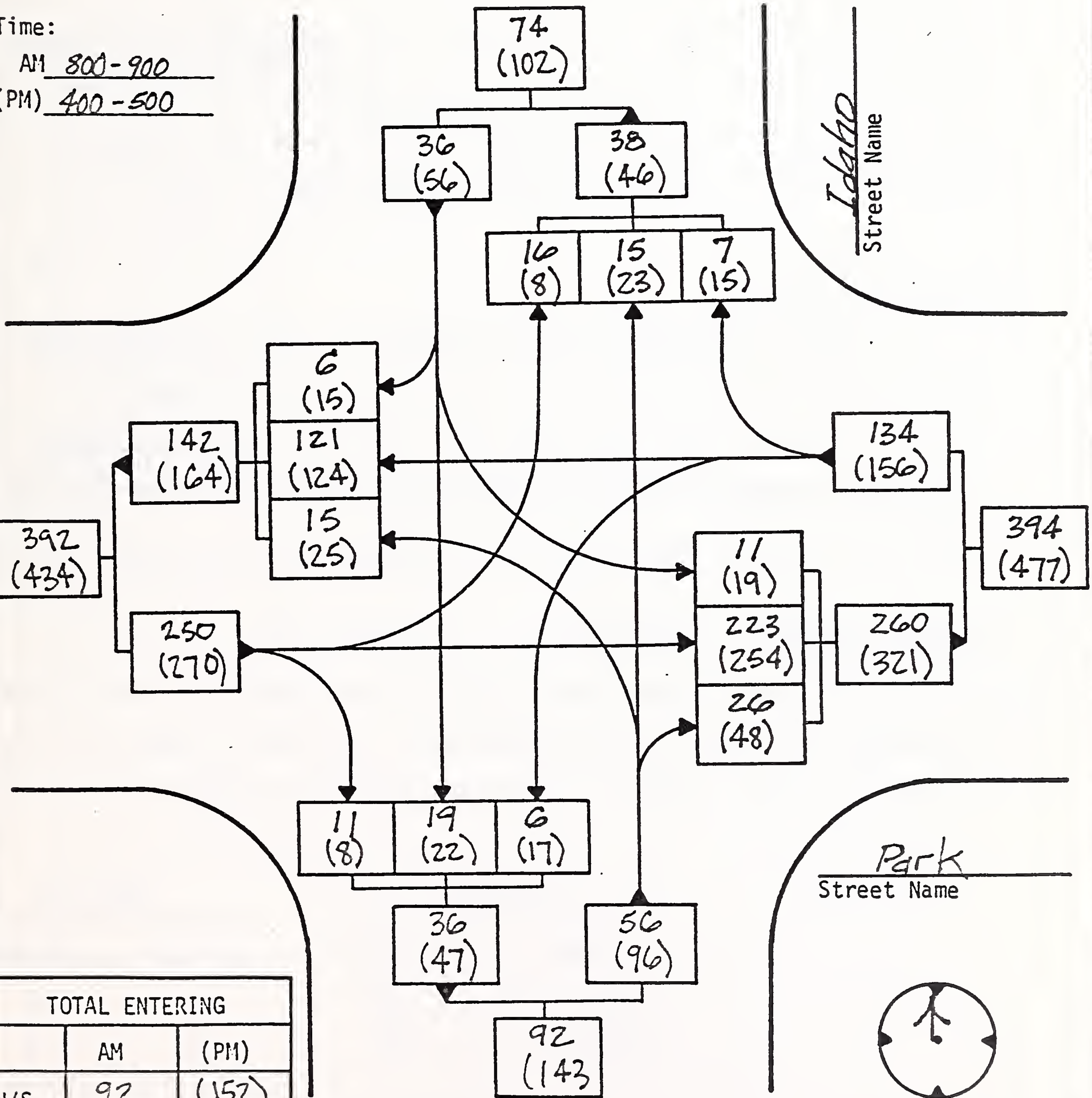
Intersection of Idaho and Park

City Butte Montana

Time:

AM 800-900

(PM) 400-500



TOTAL ENTERING		
	AM	(PM)
N/S	92	(152)
E/W	384	(426)
Total	476	(578)

CSSA Traffic Form 104

SHORT TERM IMPROVEMENTS

The Short Term Improvements sketch outlines the recommended signing and striping improvements. The basic intent of the changes is to provide left-turn lanes on Idaho Street due to the significant left-turn movements. This will require striping as shown. Also, regulatory signs indicating lane assignment should be mounted on the signal mast arms. In addition to the improvements shown on the sketch, the amber clearance interval should be increased to 4.0 seconds, in order to provide more driver reaction time.

LONG TERM IMPROVEMENTS

There are no recommended long term improvements since the volume counts at the intersection indicate that the street and intersection capacity is significantly greater than required and with the completion of short term improvements, adequate operation of the intersection will be maintained in the future.

ECONOMIC BENEFIT

The anticipated accident reductions and related benefits derived from the recommended improvements are calculated below. The method of computation and forecasting accident reduction is detailed in the "Study Methodology" section of this report.

IMPROVEMENTS	ACCIDENTS		REDUCTION	
	Type	% of Total	% of Type	% of All Accidents
	Angle	43	60	26
	Rear-End	14	20	3
	Backing	14	50	7
	Total % Reduction of All Accidents			36

BENEFITS (Dollar Values)

(% Reduction) x (Accidents/Year) x (Useful Project Life) x (Average Severity)

Short Term: (0.36) x (2.8) x (5) x (3,642) = $18,360

PRELIMINARY COST ESTIMATE

Short Term Improvements

Item	Quantity	Unit	Unit Price	Cost
Pavement Markings (Plastic Overlay)	3400	L.F.	$ 1.75	$5,950
Signs	4	Ea.	110.00	440
		Total Short Term Improvements Cost		$6,390

COST BENEFIT RATIO

The cost benefit ratio is calculated below. Not included in the cost are: Administration, engineering, replacement, and maintenance.

Cost $/Benefit $ = 6,390/18,360 = 0.3480

ACCIDENT SUMMARY

SITE NUMBER 19 LOCATION Idaho - Park REPORTING PERIOD November 27, 1979

NUMBERS OF ACCIDENTS

MONTH	NO.
JAN.	
FEB.	1
MARCH	1
APRIL	
MAY	1
JUNE	
JULY	
AUGUST	
SEPT.	1
OCT.	2
NOV.	1
DEC.	

DAY OF WK.	NO.
SUN.	
MON.	4
TUES.	
WED.	1
THUR.	
FRI.	2
SAT.	

WEATHER	NO.	ROAD CONDITION	NO.
CLEAR	5	DRY	3
RAIN		WET	1
SNOW	2	SNOWY	1
FOG		ICY	2
OTHER		OTHER	

LIGHT CONDITION	NO.
DAY	7
DAWN OR DUSK	
DARK LIGHTED	
DARK UN-LIGHTED	

ACCIDENT TYPE	NO.
ANGLE	3
LEFT TURN	
REAR END	1
HEAD ON	
SIDE SWIPE	
PARKED VEHICLE	2
BACKING	1
FIXED OBJECT	
PED.	
ANIMAL	

YEAR & SEVERITY	NO.
1977 FATAL	
INJURY	
PROPERTY DAMAGE ONLY	4
1978 FATAL	
INJURY	
PROPERTY DAMAGE ONLY	2
1979 FATAL	
INJURY	
PROPERTY DAMAGE ONLY	1

HAZARD INDEX

BASIC COMPUTATIONS

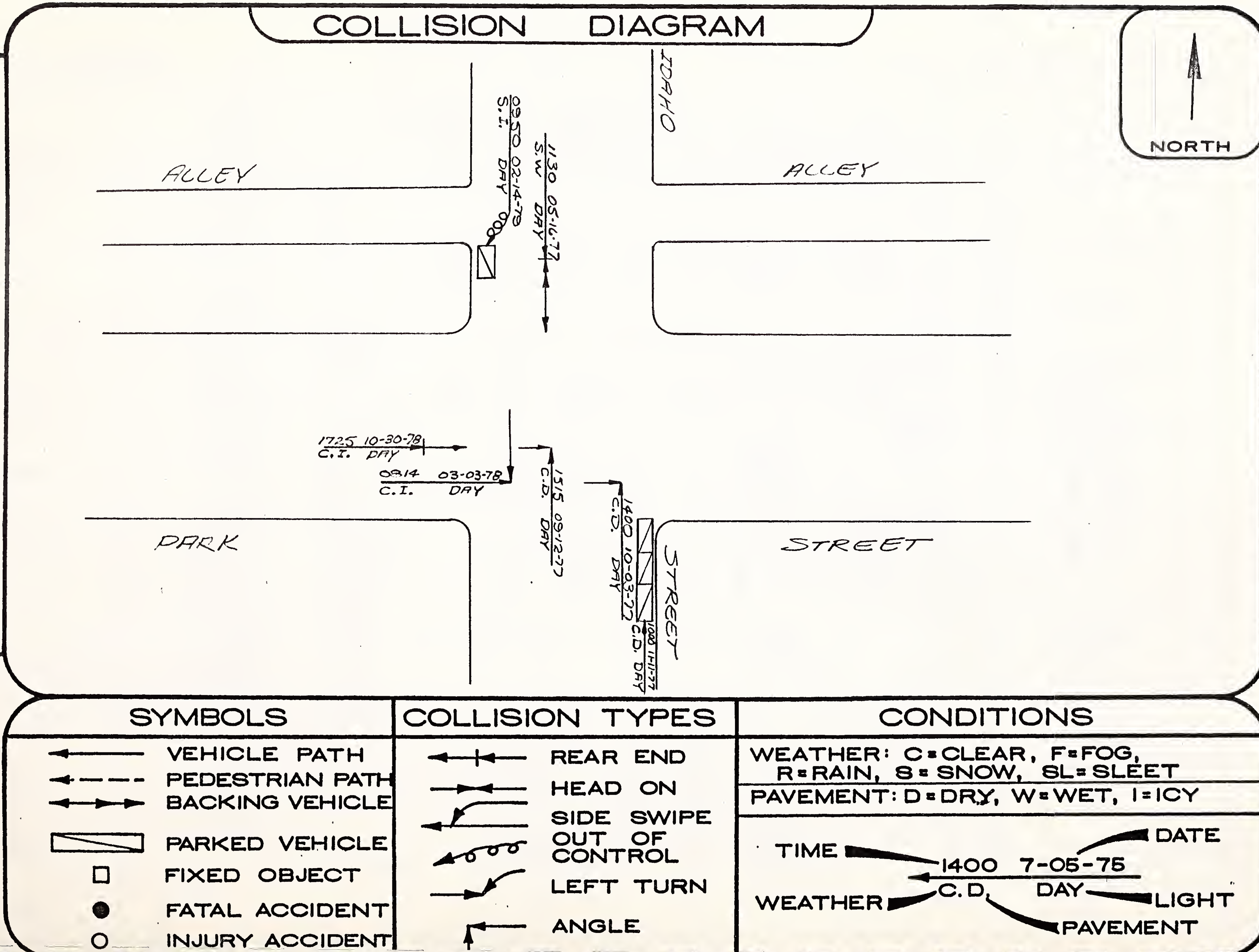
Site Number 19 Date November 27, 1979

Description Idaho - Park

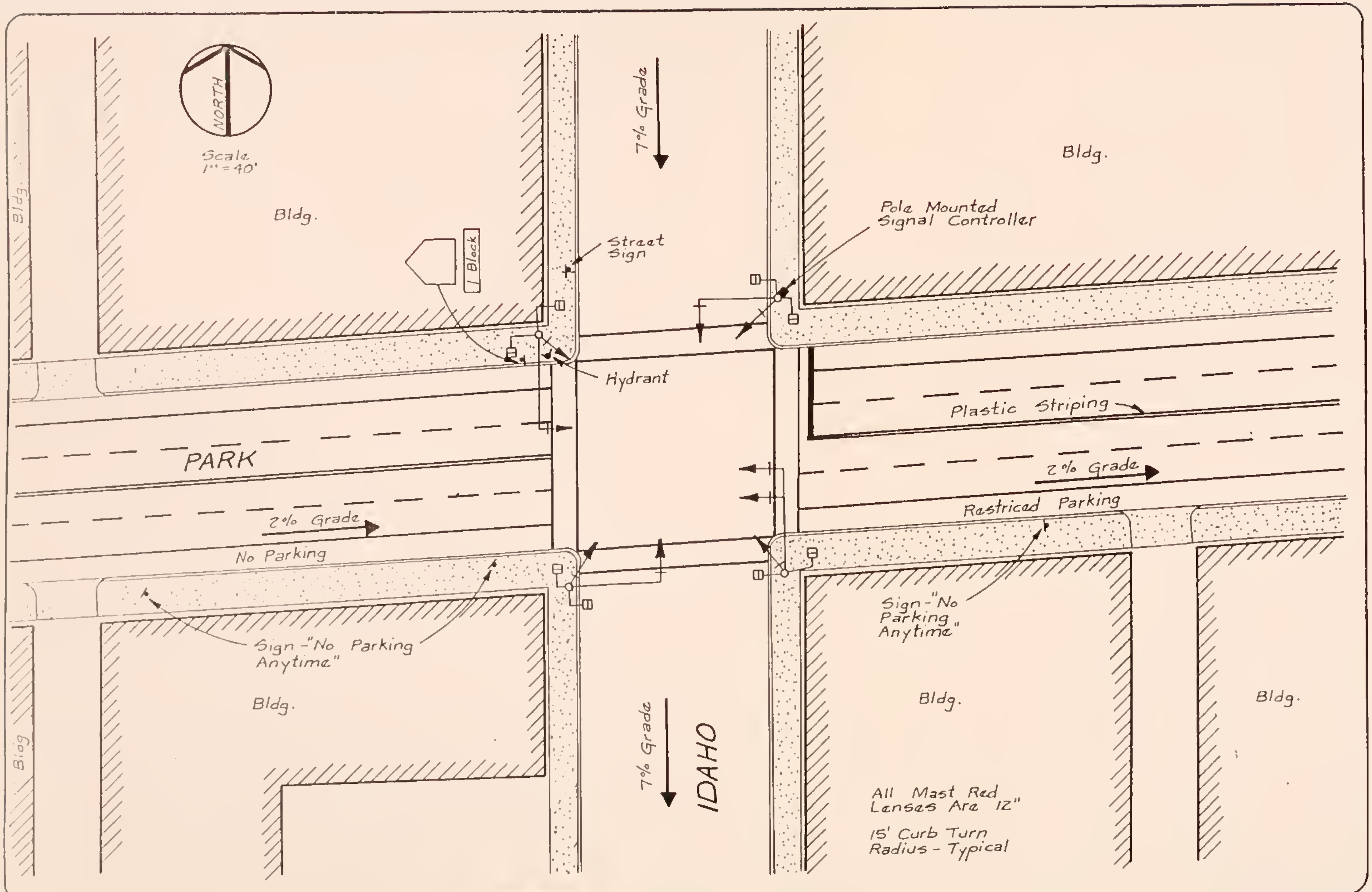
Indicator	Data Value		Indicator Value		Weight		Partial H.I.'s
Number of Accidents	2.8	acc/yr	39	x	0.145	=	5.66
Accident Rate	1.05	acc/MEV	22	x	0.199	=	4.38
Accident Severity	3,642	dollars	42	x	0.169	=	7.10
Volume/Capacity Ratio	0.12		32	x	0.073	=	2.34
Sight Distance Ratio	0.35	(wt.avg.)	84	x	0.066	=	5.54
Driver Expectancy	2.3	(wt.avg.)	38	x	0.132	=	5.02
Info. System Deficiencies	2	(wt.avg.)	33	x	0.102	=	3.37
			SUMS:		0.886*		33.41

$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{33.41}{0.886} = 37.71$$

* The "Erratic Maneuvers" and "Traffic Conflict" indices were omitted from this study. Therefore the weight factors do not total 1.00 and all sites will be ranked on an 88.6% strength of evaluation relative to the FHWA Method.



SITE NO. 19 - IDAHO - PARK



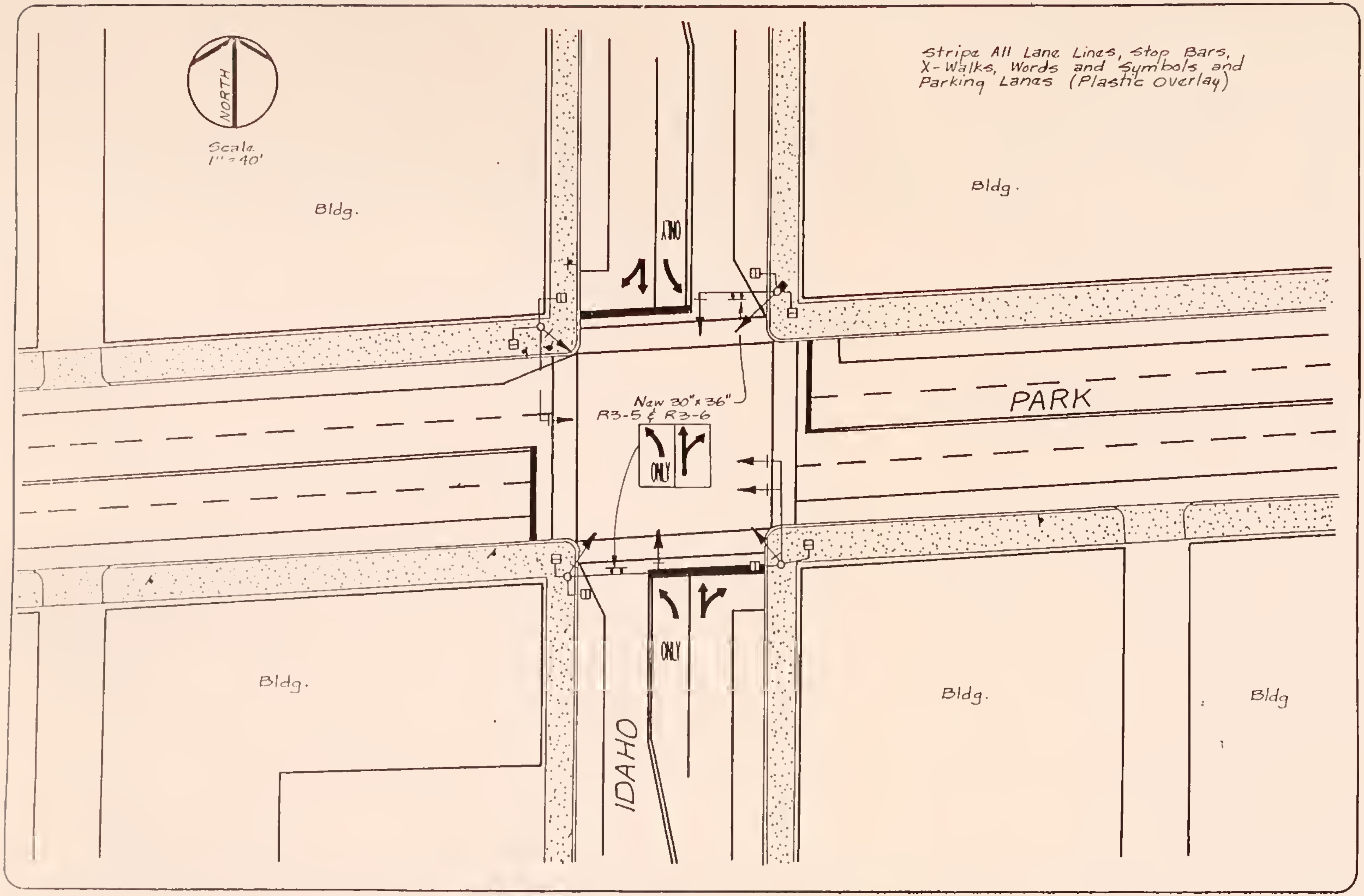
Revisions | Project

prepared by Christian, Spring, Sielbach & Associates
MONTANA
Billings
Consulting Engineering • Surveying • Photogrammetric Engineering

Sheet Title: Site No. 19
Existing Conditions
Idaho - Park

Survey Book No. / Field Work by / Designed by / Drawn by / Checked by / Date

Client No. / Project No. / Sheet No. of



Prepared by Christian, Spring, Sielbach & Associates
MONTANA
Consulting Engineering • Surveying • Photogrammetric Engineering

Sheet Title: Site No. 19
Short Term Improvements
Idaho - Park

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20

SITE NUMBER 20

MAIN STREET - SECOND STREET

LOCATIONS DESCRIPTION

The intersection of Main Street and Second Street is located south of the Central Business District of Butte. Main Street is a north-south collector street and Second Street is a east-west collector.

EXISTING CONDITIONS

Geometrics. The Existing Condition Sketch details the geometrics of this intersection and illustrates the surrounding topographic features. The intersection is a skewed, four-legged intersection with buildings on all four corners. The combination of topography and geometrics presents some severe sight restrictions. The grade on all approach legs are noted on the sketch and are considered moderate.

Signalization. The intersection is presently signalized and is controlled by a pole-mounted, semi-actuated, solid-state controller. The actuation mode is provided on Second Street (assumed loop detectors). Both Main and Second Streets amber clearance intervals are 3.0 seconds. All signal heads are 8-inch diameter lenses and all pedestrian signals have 3-inch high letters. The Main Street pedestrian crossing has a separate pedestrian actuated phase.

Signing. There is currently no signing pertinent to the operation of this intersection with the exception of a stop sign on an entering side street south of the intersection.

Pavement Markings. There are currently no pavement markings on the street sections.

Traffic Volumes. The figure on the following page is a graphic summary of the turning movement volume counts taken during an afternoon period. The Average Daily Traffic (ADT) expansion from this hourly count with appropriate expansion factors produces a north-south entering traffic of 6100 and an east-west entering traffic volume of 1400. Twenty-four hour machine counts taken in December 1979 agreed quite closely with this volume expansion. The Montana Department of Highways does not have any annual count data for 1977 and 1978 in the location of this intersection.

Traffic Operations. During field observation of the intersection during peak and non-peak hours, it was noted that the intersection operates efficiently with few conflicts. However, the proper lane designation of the street seems to confuse motorists. It is apparently not clear whether Main Street is a two or four lane street and is used both ways depending on the conditions of traffic loading.

ACCIDENT ANALYSIS

In the two and one-half year period from 1977 through June of 1979, there were a total of six accidents. The majority of accidents occurred during clear weather an on dry pavement during various conditions of lighting. The primary type of accident was the angle accident and the only reported accident was that involving a fixed object. The collision diagram shows that the majority of angle accidents occured with northbound and westbound cars at the skewed leg of Second Street. This condition is undoubtedly due to limited sight distance and visibility of signal indications.

GRAPHIC SUMMARY OF VEHICLE MOVEMENTS

Observer Ken Behling Date 11/15/79 Day Thursday

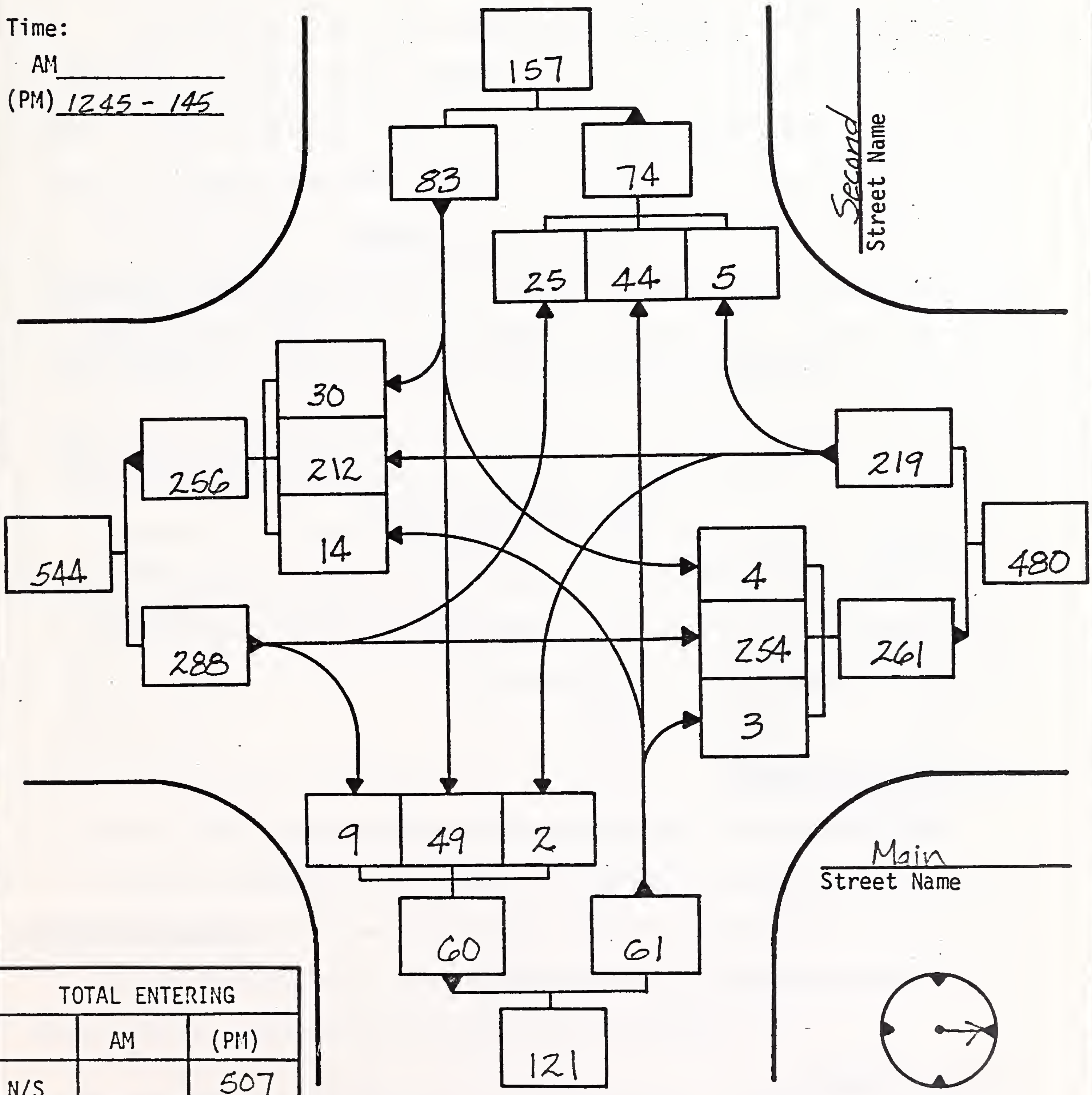
Intersection of Main and Second

City Butte Montana

Time:

AM ____________

(PM) 1245 - 145



TOTAL ENTERING		
	AM	(PM)
N/S		507
E/W		144
Total		651

SHORT TERM IMPROVEMENTS

The Short Term Improvement Sketch details the signing, striping and signal modifications felt necessary to improve the safety and operation of this intersection. Indicated are crosswalks, stop bars, centerlines, and lane lines including the schematic plan for the intersection south of Front Street where Missouri enters Main at a skew. Due to the unusual geometrics of the intersection, it is necessary to install pedestrian regulatory signs indicating that crossings should be made at crosswalks. Also because of the unusual geometrics of the intersection, the "No Turn On Red" restriction should be applied. The sign must be mounted on the signal mast arms and directed toward westbound and southbound approach traffic. In addition to these improvements it is also recommended that the mast-mounted signal heads be modified to include a 12-inch diameter red lense to increase visibility for approach traffic. The amber clearance interval should be increased to 4.0 seconds to insure adequate driver reaction time. The pedestrian signal on Main Street should be rewired or otherwise repaired since the Walk and Don't Walk lights appear at the same time.

LONG TERM IMPROVEMENTS

Since the functional requirements of this intersection are fixed and no significant changes are foreseen, no long term improvements for this intersection can be made. The short term improvements will adequately handle a substantial increase in traffic volumes.

ECONOMIC BENEFIT

The anticipated accident reductions and related benefits derived from the recommended improvements are calculated below. The method of computation

and forecasting accident reduction is detailed in the "Study Methodology" section of this report.

IMPROVEMENTS	ACCIDENTS		REDUCTION	
	Type	% of Total	% of Type	% of All Accidents
Short Term:	Angle	71	80	57
	Total % Reduction of All Accidents			57

BENEFITS (Dollar Values)

(% Reduction) x (Accidents/Year) x (Useful Project Life) x (Average Severity)

Short Term: (0.57) x (2.4) x (5) x (4, 357) = $29,800

PRELIMINARY COST ESTIMATE

Short Term Improvements

Item	Quantity	Unit	Unit Price	Cost
Pavement Markings (Plastic Overlay)	6900	L.F.	$ 1.75	$ 12,075
Signs	4	Each	110.00	440
Relocate Sign	1	Each	70.00	70
Repair Signal	1	Each	400.00	400
Modify Signal Head (12" Lens)	4	Each	175.00	700
TOTAL Short Term Improvements				$ 13,685

COST BENEFIT RATIO

The cost-benefit ratio is calculated below. The costs do not include: administration, engineering, replacement and maintenance.

Cost $/Benefit $ = 13,685/29,800 = 0.4592

ACCIDENT SUMMARY

SITE NUMBER 20 LOCATION Main - Second REPORTING PERIOD November 27, 1979

NUMBERS OF ACCIDENTS

MONTH	NO.
JAN.	
FEB.	
MARCH	1
APRIL	1
MAY	1
JUNE	1
JULY	1
AUGUST	
SEPT.	1
OCT.	
NOV.	
DEC.	

DAY OF WK.	NO.
SUN.	
MON.	1
TUES.	
WED.	1
THUR.	
FRI.	2
SAT.	2

WEATHER	NO.
CLEAR	6
RAIN	
SNOW	
FOG	
OTHER	

ROAD CONDITION	NO.
DRY	4
WET	1
SNOWY	
ICY	1
OTHER	

LIGHT CONDITION	NO.
DAY	3
DAWN OR DUSK	1
DARK LIGHTED	1
DARK UN-LIGHTED	1

ACCIDENT TYPE	NO.
ANGLE	5
LEFT TURN	
REAR END	
HEAD ON	
SIDE SWIPE	
PARKED VEHICLE	
BACKING	
FIXED OBJECT	1
PED.	
ANIMAL	

YEAR & SEVERITY	NO.
1977 FATAL	
INJURY	1
PROPERTY DAMAGE ONLY	1
1978 FATAL	
INJURY	
PROPERTY DAMAGE ONLY	3
1979 FATAL	
INJURY	
PROPERTY DAMAGE ONLY	1

HAZARD INDEX

BASIC COMPUTATIONS

Site Number 20 Date November 27, 1979

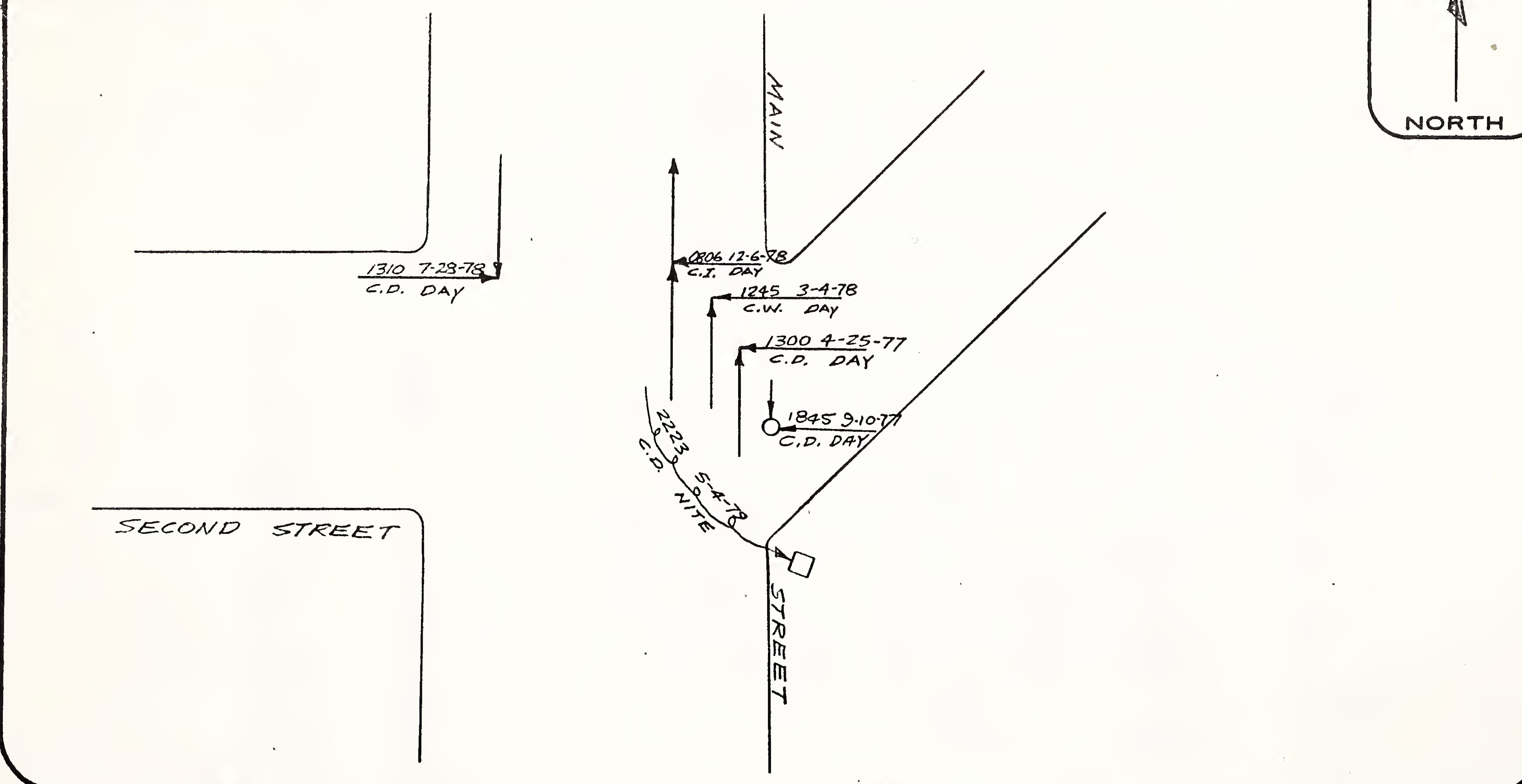
Description Main - Second

Indicator	Data Value		Indicator Value		Weight		Partial H.I.'s
Number of Accidents	2.4	acc/yr	37	x	0.145	=	5.37
Accident Rate	0.88	acc/MEV	21	x	0.199	=	4.18
Accident Severity	4,357	dollars	45	x	0.169	=	7.61
Volume/Capacity Ratio	0.08		26	x	0.073	=	1.90
Sight Distance Ratio	0.29	(wt.avg.)	87	x	0.066	=	5.74
Driver Expectancy	3.3	(wt.avg.)	55	x	0.132	=	7.26
Info. System Deficiencies	2.5	(wt.avg.)	42	x	0.102	=	4.28
			SUMS:		0.886*		36.34

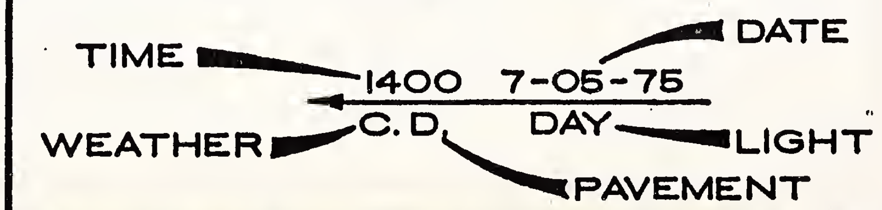
$$H.I. = \frac{\text{Sum of Partial H.I.'s}}{\text{Sum of Applicable Weights}} = \frac{36.34}{0.886} = 41.02$$

* The "Erratic Maneuvers" and "Traffic Conflict" indices were omitted from this study. Therefore the weight factors do not total 1.00 and all sites will be ranked on an 88.6% strength of evaluation relative to the FHWA Method.

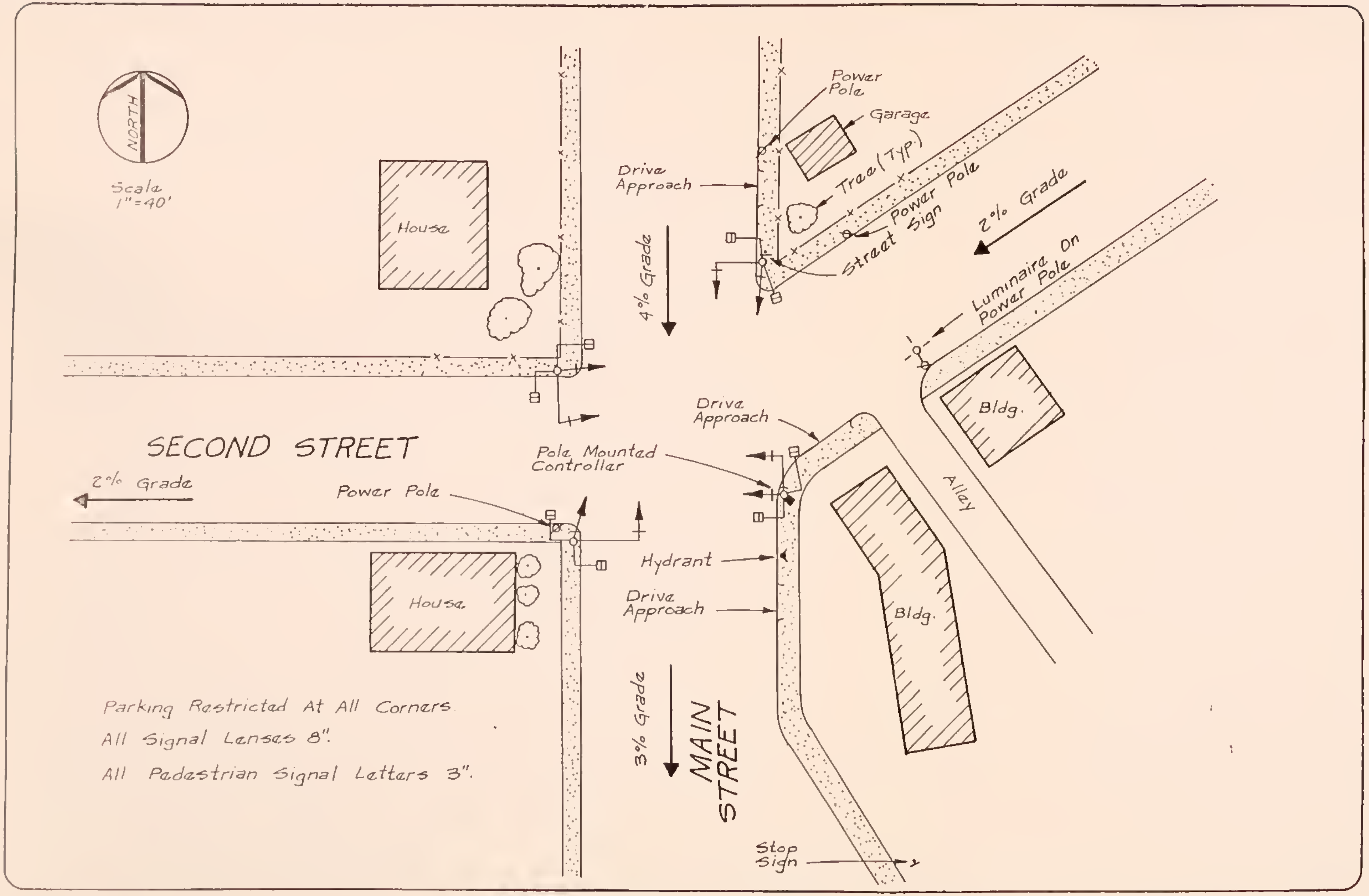
COLLISION DIAGRAM



SYMBOLS	COLLISION TYPES	CONDITIONS
VEHICLE PATH	REAR END	WEATHER: C=CLEAR, F=FOG, R=RAIN, S=SNOW, SL=SLEET
PEDESTRIAN PATH	HEAD ON	PAVEMENT: D=DRY, W=WET, I=ICY
BACKING VEHICLE	SIDE SWIPE	
PARKED VEHICLE	OUT OF CONTROL	
FIXED OBJECT	LEFT TURN	
FATAL ACCIDENT	ANGLE	
INJURY ACCIDENT		



SITE NO. 20 - MAIN - SECOND



Revisions: No. Date / No. Date / No. Date / No. Date / No. Date

Project

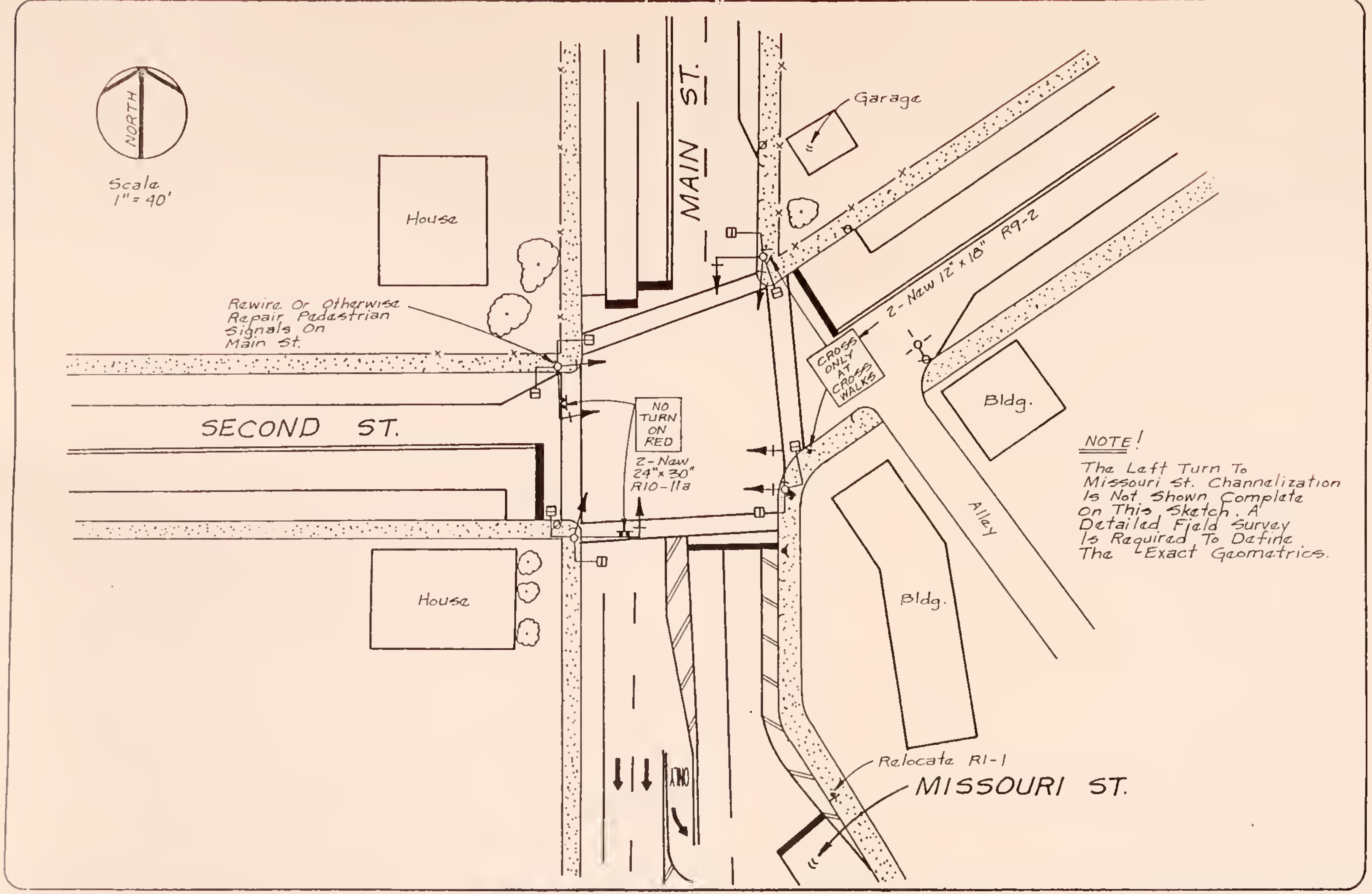
prepared by Christian, Spring, Sielbach & Associates
MONTANA
BILLINGS 2020 Grand Avenue
HAVRE 126 First Street
Consulting Engineering • Surveying • Photogrammetric Engineering

Sheet Title: Site No. 20
Existing Conditions
Main - Second

Survey Book No.
Field Work by
Designed by
Drawn by
Checked by
Date

Client No.
Project No.

Sheet No.
of



Revisions	Project:	prepared by Christian, Spring, Sielbach & Associates	Sheet Title:		Client No.	Sheet No.
No. ___ Date ___		MONTANA	Site No 20	Survey Book No. ___	Project No.	of ___
No. ___ Date ___			Short Term Improvements	Field Work by ___		
No. ___ Date ___			Main - Second	Designed by ___		
No. ___ Date ___				Drawn by ___		
No. ___ Date ___		Consulting Engineering • Surveying • Photogrammetric Engineering		Checked by ___		
No. ___ Date ___				Date ___		